Ontology-Driven Legal Support-System in the Air Transport Passenger Domain

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Abstract. This paper aims to present a preliminary version of asupport-system in the air transport passenger domain. This system relies upon an underlying ontological structure representing a normative framework to facilitatethe provision of contextualized relevant legal information.This information includes the passenger's rights and itenhances self-litigation and the decision-making process of passengers.Our contribution is based in the attempt of rendering a user-centriclegal informationgroundedon case-scenarios of the most pronounced incidents related to the consumer complaints in the EU.A number ofadvantages with respect to the current state-of-the-art services are discussed and a case study illustrates a possible technological application.

1   Introduction

Air transport passenger's realm, not withstanding being one of the most regulated[1] consumer-facing industry, unleashes a high number of disputes, due to its non-conforming performance (featured by flight disruptions, such as overbooking, long delays, cancelations, missing baggages orpoor service quality) and also to extraordinary circumstances[2] out of the airline's actual control, as depicted in Figure 1 and 2. We are cognizant of the main reasons[3] underlying this failure, which stems from: i)

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[1]   Complex patchwork of regulation composed principally by Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights, European Communications, etc.

[2]   Events that are beyond the airline's control, such as political instability, meteorological conditions incompatible with the operation of the flight, security risks, unexpected flight safety shortcomings, strikes affecting the operation of an operating air carrier, natural disasters; Draft list of extraordinary circumstances following the National Enforcement Bodies (NEB) meeting held on 12 April 2013, available in http://ec.europa.eu/transport/themes/passengers/air/doc/neb-extraordinary-circumstances-list.pdf.

[3]   Air Passenger Rights Revision - summary European Commission - MEMO/13/203, available in
       http://europa.eu/rapid/press-release_MEMO-13-203_en.htm.

existent legal grey areas; ii) unawareness of passengers' rights and iii) complex complaint handling procedures.

The objective is to render the necessary contextualized customized air-travel legal information, "at the point" of dispute resolution, for an early case assessment and to promote self-litigation in out-of-court disputes between passengers and operators. An account for the grounds for complaints is presented in [1].

Our approach, in particular, is enhanced with Semantic Web technologies that permits standards-based legal knowledge representation, which enables the possibility of legal information reuse over the web and also possibly through other stakeholders, such as National Enforcement Bodies, ECC-Net, European institutions, airlines and business from the travel sector.This assertion substantiates the research question of this paper: how to represent in an intelligent support-system the legal relevant information in the Air Transport Passenger's domain(ATP), the incidents that cause the main disputes and the workflow to follow in case of a complaint, permitting both consumers and airlines to understand their legal position and make an informed decision in run-time assets.
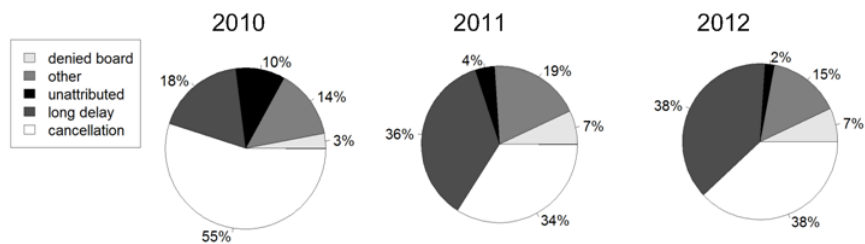
Fig. 1. Evolution of distribution between grounds for lodging complaints in 2010-2012[4]

The rest of this paper is structured in the following way. The next section will reflect the existing related services in the ATP domain. In Section 3 we describe the structure of the networked ontologies, its formalization and a case-study furnishes an illustration of a possible technical application.In Section 4 we conclude, outlining the future work.

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[4] SWD (2014) Commission Staff Working Document, Document on Complaint handling and enforcement by Member States of the Air Passenger Rights Regulations, p. 24
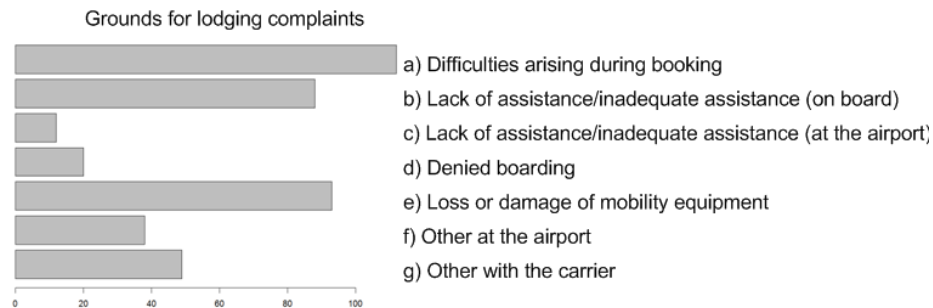
Fig. 2. Grounds for lodging complaints in 2012[5]

2 Background

Several initiatives have been approached supporting Online Dispute Resolution [1]-[6], but also concretely in the ATP domain, such as Flightright[6] and Getairhelp[7] which establish a free compensation calculator that a passenger might be entitled to in case of flight disruption. Their procedure is defined as follows: if there is a positive estimation from the compensation calculator they will manually evaluate the chances of a successful claim collection. If the prospects are promising, thereby they bring the claim forward against the airline, tracking its status. It follows that when every airline does not respond to the demand for payment or declines to pay, these companies recommend each user to engage the commissioned lawyers with no further costs.

Conversely, when reviewing these existing commercial initiatives, a number of points for improvement can be identified.Both approaches do not manage baggage incidents (delayed, missing and damaged baggage) and their corresponding rights —as we intend to use in the forthcoming future —neither incidents related to service claims (such as irresponsiveness by the airline; bad quality service; misinformation) which beget also disputes and legitimate grounds of redress.

We contend that the contextualized information regarding the procedures to claim and involved institutional entities are out of the spectrum of the provision of these services, information which we assume a priori welfare-enhancing self-litigation and empowering the decision-making process.Also, producing an interface with public and official linking-sources could be of added-value (e.g. meteorological bulletin website to check the weatherconditions to assure of the claimed adverse weather conditions; or other sources to rely in case of the event of strikes, security risks or political crises).

From the parameterised procedure we may concede they do not comprehend overall legal framework, case law, best practices nor links to official legal sources.The respective websites include a long list of frequent asked questions for more informa-

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5   *Ibid.*, p. 51.
6   http://ww.flightright.com/
7   http://www.getairhelp.com

tion if needed, in order for the end-user possibly find his answer; and if the question is not listed, the user is invited to contact directly the respective customer service or the ticket counter.Further, as commercial initiative, these websites are limited to provide help in the cases of their interest.

It is worthwhile to mention that the (EC) Regulation establishes minimum standards of assistance and compensation for passengers affected by denied boarding or by long delays or cancellations, regardless of the fact of an actual damage. Hence, passengers shall retain the right for further claims beyond this minimum standard, as the national legislators can go beyond the compensation rules established by the Regulation. In this regard, Article 12 stipulates that passengers are not hindered from further claims, if the damage occurred exceeds the compensation awards as under Art. 7. By offering information inasmuch as these service providers are interested, encompassing a monetary estimation may seem reductant.

These services are again of limited help. Their course of action (stage of the process, enforcement of the claim) still leans on each airline's regulation policies and their willingness for settlement; accordingly, only when air carriers are willing to settle with these service providers, the consumer succeeds.

One of the main limitations of these systems relates to the collection of information for enabling any decision: claims and requirements are collected by a fixed-structure template to be filled in by parties, regardless of their own narrative.

3   Ontology-driven support-system

For our purposes, the ontology-based representation of conceptual legal knowledge, which supports legal decision making, proposes: i) an ontological structure aimed at modeling the juridical knowledge related to the ATP domain; and ii) a support-system targeted atexploring the ontological structure in order to provide the specific knowledge to passengers. These components are detailed in the following subsections.

3.1   Ontological structure and ontology requirement specification document

In this sub-section, the development of the Air Transport Passenger Incidents and Rights (ATPIR) is discussed. The first step consists of gathering both domain and development requirements that define the build-up process. The Ontology Requirements Specification Document aims to facilitate the ontology development [8]; in particular, i) enhances the search for available and existing knowledge resources to be reused in the ontology development; and ii) permits the ontology content-verification regarding the requirements that the ontology should fulfill. In Table 1 we present our ORSD of Air Transport Passenger's Incidents and Rights model (ATPIR).

Table 1. Ontology requirements document. Top: Domain requirements. Bottom: Development requirements

ATPIR Domain Requirements

Purpose	Enhancing the decision-making process through an ontology driven support-system. These set of networked ontologies intend to represent relevant information, such as the workflow of a complaint, the foremost incidents in ATP domain and the correspondent rights.
Scope	Air transport passenger incidents and rights.
Sources of knowledge	Containingdomain-specific knowledge harvested from normative frameworks: i) Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004 establishing common rules on compensation and assistance to passengers in the event of denied boarding and of cancellation or long delay of flights; ii) SWD (2014) 156 final, Commission Staff Working Document, Complaint handling and enforcement by Member States of the Air Passenger Rights Regulations (see Fig. 2) iii)The 2011 Report disclosed by the European Parliament, the ECC-Net 2011 Air Passenger Rights Report, the ECC-Net 2012 Annual Report, and the ECC-Net 2012 Alternative Dispute Resolution in the Air Passenger Rights Sector Report; iv) Bureau Européen des Unions de Consommateurs (BEUC) position on Air Passengers' Rights,Revision of Regulation 261/04 on the rights of air passengers in theevent of denied boarding, cancellation and long delays; v) Case-law from the European Court of Justice; vi) Terms and conditions of 10 air carriers; vii) As further step, it will contain a thorough analysis of passenger complaints regarding this these domain.
Ontology Requirements I:	*a) Functional requirements: competency questions which refer to the particular knowledge to be represented by the model:* 1) Does the passenger presents a relevant incident? 2)Which is the procedure to follow in case of a dispute? 3) How can the passenger lodge a complaint? 4) Which are the documents the passenger needs to sustain the claim? 5) To whom to address the claim? 6) When is the passenger eligible for redress? 7) Which are the passenger's rights in case of flight cancelation, delay and overbooking? 8) Which is the applicable legislation?
Ontology Requirements II:	*b)Non-Functional Requirements* 1) The ontology supports scenarios in the English language. 2) The ontology is based on European legal framework.
Conceptualization	It is a specific set of networked ontologies which represents knowledge related to a particular domain.
Intended End-Users	User 1. Air carriers; User 2. Passengers; User 3. Stakeholders (Regulators, Nebs, ECC-Networks)
Intended Uses (use -scenarios)	Use 1. Support-system for enhancing decision-making; Use 2. Mobile application; Use 3. Before a Complaint; Use 4. To lodge a complaint.
Development Requirements	
Methodology approach	The ontology development methodology is based on a bottom-up approach; is use-case oriented (knowledge sources for concepts and term extraction from official structured legal expert texts andlegal sources, and in the further

	future, from a corpus of passengers complaints); anchored in asocial-legal perspective.
Reuse	Reuse of concepts from LKIF-Core, Geomaps, Prov-O

3.2 Formalization

This subsection presents the knowledge base of the Air Transport Passenger Incidents and Rights. ATPIR was designed in a formal model that describes the incidents and its circumstances, tackles the complaint processing workflow and is acquainted with the applicable regulations. The ontologies reuses or maps to concepts defined in other related vocabularies such as the provenance ontology (PROV-O)[8], the LKIF core ontology [7] or Geonames[9]. The permanent, resolvable IRI of these ontologies is shown in Table 2:

Table 2. Ontologies and their IRIs

Ontology	prefix	IRI
Flight Incident	atpir-fi	http://purl.org/NET/atpir-fi
Complaint Workflow	atpir-cw	http://purl.org/NET/atpir-cw
Flight Incident Legal Framework	atpir-filf	http://purl.org/NET/atpir-filf

1. *Complaint Workflow Ontology* defines a workflow upon which a passenger might bring a complaint when a dispute arises in a complete and valid way. It comprises the iterative steps, such as a) submitting the complaint, avoiding this way irresponsiveness of the airline; and b) adding proof documents (and which) to sustain the redress request; it specifies the standard complaint format and the involved parties in the management of a complaint. In this integrative way we may tackle complex and tailor-made handling procedures, evading from difficulties encountered by passengers in enforcing their rights due to ill-defined, contingent and burdensome complaint-handling processes.

2. *Flight Incident Ontology* expresses the flight disruptions that frame the air transport dispute market: a) baggage incidents (delayed, damaged, and missing); b) flight incidents (delayed, cancelled, denied); and c) service incidents (unfair commercial practises, bad quality service and irresponsiveness), which may reveal if the passenger has a case and thus is eligible for redress (discouraging unmeritorious complaints). A class hierarchy, with a high level classification, is shown in Fig. 3. The class diagram in Fig. 3 and Fig. 4 follow the Unified Modeling Language convention (UML).

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[8] http://www.w3.org/TR/prov-o/
[9] http://www.geonames.org/ontology/
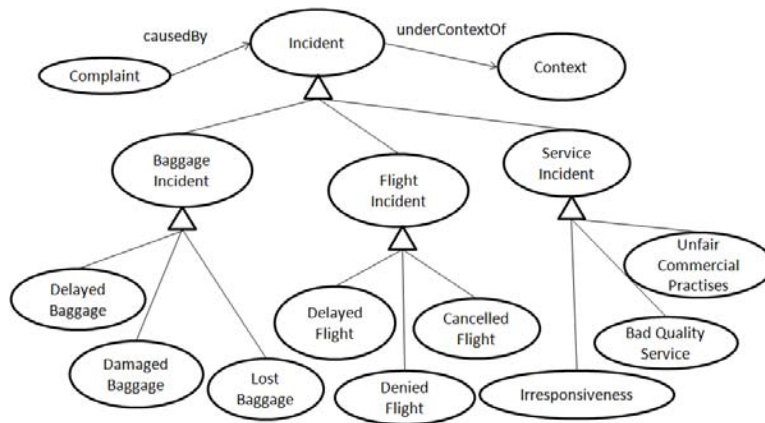
Fig. 3. Categorization of air transport passenger flight incidents

3. *Flight Incident Legal Framework Ontology* models the rights-based approach. *PassengerRights* group encloses the entitled rights related to cancelled, denied and delayed incidents, as defined both in the EC Regulation and in case-law (*Information*, *Assistance*, *Rerouting*, *Compensation*, *Reimbursement* and *Return*) and defines when and how the rights are applied. Subclasses of *Sources* will refer to the companies' policies, combined with the existent legal framework (EU Air Transport Law), which is compounded of the EU Regulation, Communications and the case-law from the ECJ (see Fig. 4).
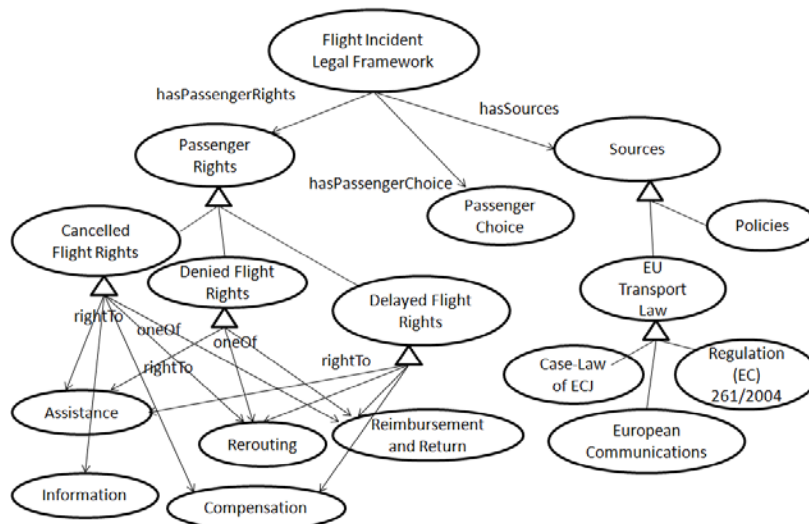
Fig. 4. Class hierarchy for the Flight Incident Legal Framework

3.3 Case-Study

The narrative of the case refers to the context of a real-life complaint[10]:

It consists in a cancelation of a flight regarding the air carrier Anonymair, with the flight number 7473, from Eindhoven, departure time at 10.50h a.m. to Porto, with the estimated arrival time at 12.25h p.m., on the 25th of March of 2012. The passenger received an email on the same day, at 9.45h a.m., from the air carrier, stating that the flight was canceled due to extraordinary circumstances, due to adverse weather conditions. In this email was declared the possibility to rebook free of charge a flight to the same destination, subject to availability. The provided flight occurred in the next day and departed from Maastricht. The consumer argues about the transport costs, accommodation and meals.

According to the construal of the legal framework, and as an early instantiation, we consider that the case falls under the scope of the (EC) Regulation (it is a Community carrier) and that the passenger has grounds for redress regarding[11]:

1. Assistance, cf. Articles 9(1)(a), 9(2), which consists of meals/refreshments, and telecommunications (two telephone calls, telex or fax messages, or e-mails); in the event of rerouting, which is our case, when the reasonably expected time of departure of the new flight is the following day, it shall be offered accommodation and transport between the airport and the place of accommodation, cf. Article 9(1)(b) and 9(1)(c).
2. Information as a written notice setting out the rules for compensation and assistance and the possible alternative transport, Article 5, (2) and Article 14(2).
3. Choice between: (a) Refund within 7 days, Article 7(3) or (b) Re-routing, under comparable transport conditions, to their final destination at the earliest opportunity or at a later date at the passenger's convenience, subject to availability of seats.

3.4 Enabling a technological application

This ontology-driven application would encode the most relevant elements in the incident as instances of the OWL classes in the ontologies referred in subsection 2.3: passenger, air carrier, flights, airport of the incident etc. These instances would be duly attributed with OWL datatype properties (like the flight number or departure time) and related to other resources with object properties (for example connecting the flight with a departure and an arrival airport). These linked resources may be Linked Data published from external sources in a well structured manner, allowing some sort of inferences. For example, some aspects of the case study may be codified with the following RDF statements:

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[10] Provided by the Consumer Association "DECO" (http://www.deco.proteste.pt/). Complaints are mostly company confidential and aren´t available for broad publications, or they are not officially reported.

[11] It should be stated that the airline was not obliged to provide compensation in case of extraordinary circumstances, which are events that cannot have been avoided or foreseen, even if all reasonable measures had been taken, namely circumstances which are beyond the air carrier's actual control, according to Article 5, Paragraph 3, such as meteorological conditions incompatible with flight operation

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:passenger a Passenger .
:flight7473 a Flight ;
     hasFlightCode "FA7473" ;
     hasAirline :fictionAir ;
     atpir-fi:hasDeparture <http://sws.geonames.org/2735943/> ;
     atpir-fi:hasDestination <http://sws.geonames.org/2756253/>  .
```

The flight causing the incident is described with the International Air Transport Association (IATA) code number, the airline or the departure and destination airports. The airport cities are represented with resources published by Geonames, which also asserts the nation for every city. A simple query can retrieve a relevant fact about the incident: whether it happened in an intra-Communitary flight, or whether it was a long-haul flight or not. The assignment of rights to the user can be done by means of a SWRL rule:

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Incident(?i) ∧ hasFlight(?i, ?f) ∧ IntraCommunityFlight(?f) ∧ hasPar-
ty(?i, ?p) ∧ CancelledFlight(?f) ∧ reasonForCancellation(?x, "Extraordi-
nary   circumstances")   ⇒rightTo(?p,   :assistance)   ∧   rightTo(?p,
:information) ∧ rightTo(?p,;refundOrRerouting)
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The rule reads: "*If the flight is cancelled due to extraordinary circumstances, then the passenger has rights to assistance, information and refund or rerouting*". The rule depends on the provided information (e.g. it is true that there were extraordinary circumstances), but it can help passengers with some information to consider before lodging a complaint, abandoning the actual claim or adjudicating their case in court.

4   Conclusion and future work

So far, regarding our knowledge acquisition process, the elicitation of conceptual knowledge, in which we have supported our modeling decisions, derived from structured normative sources with expert generated content (legislation, case-law, legal expert texts, reports, surveys and policies of the ten airlines).

The ongoing construction process of the ontologies and its formalization will also configure and rely on the analysis of a database of consumer complaints to model the case-scenarios, within a social-legal perspective [9].The aim of thiskind of approach is to provide the needed technology to solve specific end-users needs. In our cartographic line, wewillstart by encompassing the remaining incidents (service and baggage incidents) and their correlative rights, supported by legal and empirical sources. Wewill also reuse terms of related legal ontologies,and will link to legal sources and official documents.Further complexity will be added into the ATPIR model with the formalization of other class relationships, other constructs and the incoming ontology population. Exceptional circumstances may be further described and related to external events whenever it is possible. Expert-based ontology evaluation will be regarded, in particular, with legal expert validation (researchers, academics and professionals) and further reasoning capabilities.

We presented the preliminary steps towards the intended ontology-driven support-system for the enhancement of the decision-making process of the disputants, with

semantic capabilities, which is in its groundwork stage with the limitations of an early stage proposal, but it is a footstep in the direction of the semantic web applied in the air transport passengers domain.

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