Policy Modeling with ODRL: Framework, Lifecycle and Inference for Machine Processing of Legal Regulations

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Abstract. Background: In the current Digital World, data is being produced and consumed more than ever before in almost every sector of life, resulting in data as one of the most valuable assets for any organization. Parallel to this growth in data production and consumption, new rules, regulations, laws and legal boundaries are being defined by corresponding authorities for data protection, controlled legal usage, sharing, and trading.

Problem: This growth in data and corresponding legal documents and laws about data usage demands new approaches and tools for automated assessment and compliance checking of data-oriented operations especially when it comes to AI operations.

Solution: In EU funded project, ACCOMPLISH (Automated Assessment and Certification Compliance of Organisations, Systems, Data and AI Operations in a Human Understandable Context), we aim at developing a framework for automated assessment and certification of compliance policy models for Data and AI Operations.

As initial results of the ongoing project (i.e. ACCOMPLISH), in this paper we present a methodology to keep an eye on regular updates in legal documents and laws with a comparative overview of various EU data and AI regulations. We also present the domain-specific personas designed and used for requirements gathering in four domains (i.e., Automotive, Aviation, Energy and Robotics). Various use cases are presented from these domains to check compliance against legislation, user-generated regulations, digital products, AI operations, and organizational practices.

Finally, we also present the process of extracting and identifying requirements for compliance policy modelling and then to implement it by using ODRL.

Keywords: Government Data · Data Analysis · Data Digitization.

1 Introduction

In the current Digital World, data is being produced and consumed more than ever before. Parallel to this growth in data production and consumption, new rules, regulations, laws and legal boundaries are being defined by corresponding legal authorities and departments.

This growth in data and corresponding legal documents and laws about data usage demands new technologies that can be used for encoding these legal laws and regulations in a machine understandable format, such that process of compliance assessment and checking of data and AI operations could be performed in an automated way.

In EU funded project, ACCOMPLISH (Automated Assessment and Certification Compliance of Organizations, Systems, Data and AI Operations in a Human Understandable Context), the task "ACCOMPLISH Multi-faceted and Domain Extendable Compliance Policy Models Design" targets to address these issues by developing Compliance Policy Models Repository that can be used for automated compliance assessment and certifications of data and AI operations.

2 Related Work

As part of ACCOMPLISH project, policy modeling for automated compliance assessment and certification needs to investigate the state of the art from several perspectives such as legal, theoretical and technical. From technical perspectives we have several candidate approaches that can be used for policy modeling such as Open Digital Rights Language (ODRL), Web Ontology Language (OWL), Shapes Constraints Language (SHACL), and Semantic Web Rule Language (SWRL). Among all, a technical and feasibility study in the ACCOMPLISH project resulted in the ODRL to be the best suitable choice for policy modeling in the project perspective [7][12] [8]. ODRL provides a very comprehensive information model that can be used to model the policy flow in a very comprehensive way. In addition to this several profiles of ODRL such as Data Privacy Vocabulary (DPV) [6][11], Vocabulary for High Risk AI Systems [4], and vocabulary do define Access Controls [1]. Additionally, AI Risk based Ontology [3], [9] provides vocabulary that specifically focuses on modeling entities of GDPR articles [2][10] , EU AI Acts [5][13] etc. ODRL, together with all these profiles provides a very comprehensive set of vocabularies required to do policy modeling for GDPR Articles, Data Acts, AI Acts and Data Governance Acts.

3 Regulatory Radar for Continuous Regulations Monitoring

For ACCOMPLISH, scientific and technology radar activity is a continuous and significant because it confirms that compliance requirements are not only expanding, but are also being progressively reorganised to reduce overlaps, cumulative obligations, and unnecessary complexity. The monitoring of the Digital

Omnibus, therefore, reinforced the need for compliance approaches that remain adaptable to regulatory consolidation processes and can reflect changes in the interaction between horizontal digital regulations and sector-specific legal frameworks. In parallel with the regulatory analysis, the radar includes a systematic technology watch over scientific literature, industry reports, online sources, existing compliance tools, and related European initiatives. The objective is to identify relevant technologies and trends and assess their alignment with ACCOMPLISH's objectives and intended solution space (as shown in Figure 2).

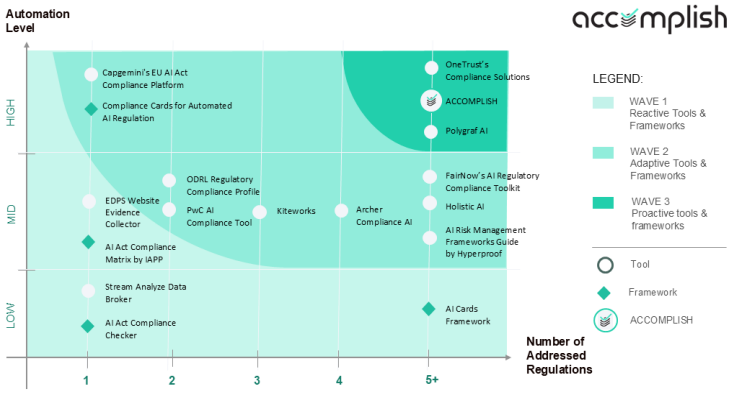

Fig. 1. Compliance technologies solutions mapping within the technology radar activity.

4 Methodology for Synchronization Between Requirements and Policy Models (MSRP)

As the name (i.e., *Methodology for Synchronization Between Requirements and Policy Models (MSRP)*) suggests that *MSRP* starts with the selection of legal articles, laws, regulations and acts that are related to data&AI Ops of AI based systems. These selected legal articles and regulations are then used to identify and extract compliance requirements creating the base for developing policy models which ultimately are used for compliance assessment of data&AI Ops in an automated way (as shown in the Figure 2). In *Phase I* Human-in-the-Loop (HITL) approach is used in requirements gathering and policy modeling, therefore in this phase legal documents are selected on manual basis with

common understanding of technical and legal experts based on mutual discussion, importance and relevance of legal articles to the data&AI Ops. In *Phase II* compliance requirements from selected legal articles are identified, extracted and documented such that they can easily be used by technical team for policy modeling purposes. One major issue faced during this phase was how to document the identified compliance requirements such that they become clear, easy to understand and properly structured in a way that they can easily be used by technical experts for compliance policy modeling purposes. In *Phase III*, compliance policy requirements are taken as input for phase III for policy modeling purposes. Each requirement from the CPRT is translated to the corresponding policy instruction encoded in ODRL as core information model and its various profiles as suitable vocabulary containers.

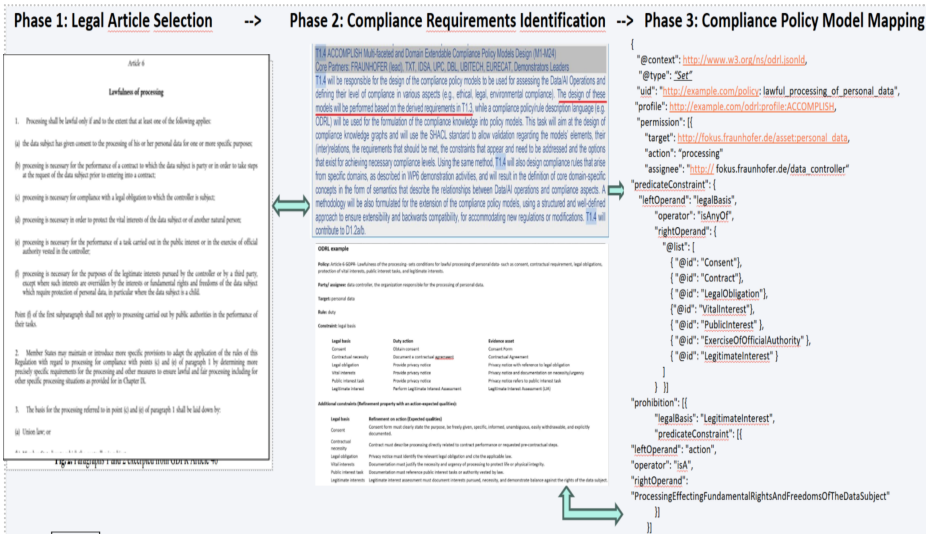

Fig. 2. Different phases of *Methodology for Synchronization Between Requirements and Policy Models (MSRP).*

5 Extendable Compliance Policy Models Repository (ECPMR)

Extendable Compliance Policy Models Repository (ECPMR) is basically a central compliance policies bank that is used to fuel the compliance assessment process of the ACCOMPLISH framework. Main part of the ECPMR are policy models that are developed and injected into the repository for selected articles and acts from GDPR, AI Acts, Data Acts and Data Governance Acts, based on their relevance to data&AI Ops. Here, we use the term *"extendable"* with

policy models because in ACCOMPLISH project we performed an extensive review of EU regulations from different sectors to create policy models that can be expanded with future needs as well as forth coming legal acts and regulations, as the modeling process to be employed remains the same. Additionally, as part of implementing the policy model in ODRL, compliance requirements for every article and act (as discussed in the Section 4) are taken as input and basic flow of the policy is encoded in ODRL information model. Each requirement (binary and non-binary) are taken one by one, corresponding best suitable vocabulary is searched and investigated among existing profiles of ODRL, and every requirement is mapped to suitable ODRL policy code (as shown in Figure 3).

Article No.	Legal Provision	Scope	Requirement type	Measures, actions and documentation to demonstrate compliance	Monitoring requirement	Consequences of non-compliance
10	**Data and data governance:** requires that data complies with a set of standards during development, updates or retraining.	Applies to **providers** of the high-risk AI system.	**Duty:** before placing a high-risk AI system on the market or put into service, applies also to updated involving retraining or real-world data input.	*A. Binary (yes/no):* if these elements are present, there is *evidence towards* demonstrating compliance. a. Documented data governance and dataset-quality procedures containing the following elements: - Documented data governance framework. dpv:hasOrganisationalMeasure dpv:DataGovernance - Documented dataset specification. tech:hasDocumentation aiact#CommonSpecification tech#Documentation - Documented procedures to detect and correct data errors. - Bias/ representativeness assessment. dpv:hasAssessment **dpv:DataQualityAssessment** ai#BiasDetection - Error management procedures. *B. Non-binary (require a contextual assessment):* building on the binary actions, a contextual assessment of these points is required to further verify compliance with each specific legal basis. - Statistical analysis of dataset representativeness. - Bias-detection reports (quantitative fairness metrics). risk:detects ai#ValidationDataBias - Documentation showing how identified biases were corrected. - Data validation reports. - Documentation of reviewer checks.	Verification that data used (training, validation, testing, and real-world inputs) remains appropriate, representative, complete, and free of errors for the intended purpose of the high-risk AI system, and whether data issues lead to new risks or performance degradation. ai:TrainingData ai#TestingData **ai:ValidationData** Among others: a. Existence of a documented data monitoring policy. dpv:hasPolicy dpv#MonitoringPolicy b. Documented roles and monitoring responsibilities. dpv#hasTechnicalOrganisationalMeasure **dpv:ActivityMonitoring** c. Documented monitoring schedule. dpv:hasPolicy dpv#MonitoringPolicy **dpv:PhysicalSurveillance (option)**	-Administrative fines up to €15 000 000 or 3% of total worldwide annual turnover. "leftOperand": "payAmount", "operator": "lteq", "rightOperand": { "rdf:value": "15000000.00", "xsd:decimal": true }, "unit": "http://dbpedia.org/resource/Euro" -Penalties and enforcement measures adopted at the Member State level.

Fig. 3. Requirement to ODRL vocabulary mapping.

6 Conclusion and Future Work

In this paper we presented our regulatory radar for continuous regulations monitoring. We also presented the *Methodology for Synchronization Between Requirements and Policy Models (MSRP)* that can be used to extract compliance requirements from legal documents. These requirements create the base for

compliance policy modeling. We also presented the *Extendable Compliance Policy Models Repository (ECPMR)* that consist of read-to-use policy models with Human-in-the-Loop (HITL) approach.

As part of future activities, we are working on several aspects: i) expanding and updating the *Extendable Compliance Policy Models Repository (ECPMR)* with new ready-to-use policy models as well as by updating existing policy models with new requirements, ii) standardizing, completing and publishing the ACCOMPLISH ODRL profile documentation, iii) implementing the profile as OWL ontology.

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