

## Modeling the Interpretation of Sources of Norms

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**Abstract**—In this paper, the authors present their work on the development of a formal method for the interpretation of norms. This research is a continuation of the work reported in the eKNOW 2015 conference where we focused on a formal method to relate a set of norms described in natural language to the specification of a service based on these norms. In this paper, we focus on the modeling of the explicit interpretation of norms. These interpretation models are aimed to become components in our agent-role based simulations that allow to reason about the effect of norms in social reality. The method has been tested in a governmental organization for the specification of digital services. The method preserves the original concepts in sources of norms described in natural language, and delivers a translation of these norms to formal computational models. These models can be used to support institutional reasoning, i.e., reasoning about institutional facts and normative positions.

**Keywords**—AI and Law; knowledge acquisition; knowledge representation; formal representation of norms; legal analysis; legal engineering; rule governance.

### I. INTRODUCTION

Every organization's behavior is, in some way or the other, impacted by norms. These norms are either set by the organization's policies, by contractual agreements, or they are externally imposed. Governmental agencies that have responsibility for implementing law in various client-handling processes, have a particular interest in correct execution of norms.

Formalizing sources of norms, into formal computational models that can be used in information technology (IT), has been done in many different ways, and this has been object of study in the Jurix community and the Artificial Intelligence and Law (AI and Law) community. Both communities consist of experts from the field of Information Science and Law. For an overview of approaches, we refer to Bench Capon et al. [2].

While some of the approaches described by Bench Capon made it outside academia and resulted in practical applications, large-scale application within industries and government has not yet been accomplished due to various open issues. We will discuss some important issues, before we present our solution for some of these issues.

Marek Sergot was one of the first scholars that worked on legal knowledge based systems that were supposed to be closely aligned with sources of law [15][16]. He used the British Nationality Act as study case, a domain related to the field of Immigration Law, used in this paper.

Sergot used logic programs as his language for specifications. This language, based upon first order logic representation, can be used to express and reason with norms, but at the expense of sacrificing accuracy and reusability. This is a result of the task orientation of the method used.

Also, modal logics have been applied to the field of law. Next to their computational unattractiveness, thus far no one has been able to find the right translation of 'legal abilities'. Wierenga and Meijer [18] point at various approaches using some form of modal logic and give examples of problems that come with using modal logic for expressing norms.

A general problem for translating rules in logic is the disability to handle contrary positions and multiple contradictory interpretation models. Within the AI and Law community different conceptualizations have been developed, including formal models for argumentation and factor analysis of cases, also see [2].

With the approach presented in this paper, the authors aim to support large-scale applications in complex organizational contexts. Besides the problems addressed in literature, we also gathered requirements from our experience building large-scale applications of artificial intelligence (AI) in the legal domain for many years. The formal method for the interpretation of norms described in this paper, can be used to enable organizations to design IT-systems that support their business processes in a systemic way, and should allow for easy maintenance and easy implementation of changes. While developing our method, we have tested to what extent these requirements could be met, and we will report on our experiences in a future paper. Specifications of normative systems can also be used to control whether systems comply with norms or to support the internal and external communication on the interpretation of norms.

In this paper, we explain our method and its application in one concrete case: the application for a residence permit for international students in the Netherlands. Applying for and deciding on application is a process bounded by legal norms set by law. Though legal norms have some specific properties, the method presented in this paper holds for any organization applying norms.

Currently, many organizations recognize the huge economical potential that such a method could have. This most certainly holds for governmental institutions responsible for the execution of the law and applying legal norms to a massive number of cases. This allows us to cooperate with, and test our approach in many governmental

agencies joined in the Manifesto Group, and in collaborative networks, such as the Blue Chamber [8] and the Netherlands Organisation for Scientific Research (NWO) [4].

Before going into the details of our approach, we will shortly sketch the general framework that has also been partly described in [6][7].

In section 2, a general framework of the work presented in this paper, is given. Section 3 contains an overview of the methods used. Section 4 contains an outline of a method for the interpretation of sources of norms, expressed in natural language. In section 5, a study case is presented, to illustrate the method for a formal interpretation of norms. In section 6, the results of the study case are presented. Section 7 contains a discussion on the results and an overview of future work.

## II. THE GENERAL FRAMEWORK

In our approach, we separate three layers of reality that are interconnected (see figure 1). This model is an extended version of the three layers of reality model presented in [5]:

1. Sources of Norms  
This layer describes the components, structure and referential mechanisms that allow us to refer to the natural language sources describing the norms we want to ‘translate’ into formal computational models.
2. Institutional Reality  
This layer describes the interpretation of the sources of norms in the previous layer, using: states representing situations; legal positions; and acts regulated by norms. In this paper, we focus on this layer.
3. Social Reality  
The Social Reality layer describes agents, agent-roles, collaboration of agents, coordination, message passing, and other behavioral aspects of agents. This layer is used to describe and simulate behavior in societies regulated by norms. These norms can be used, e.g., to test (non-) compliance scenarios, and to predict effectiveness.

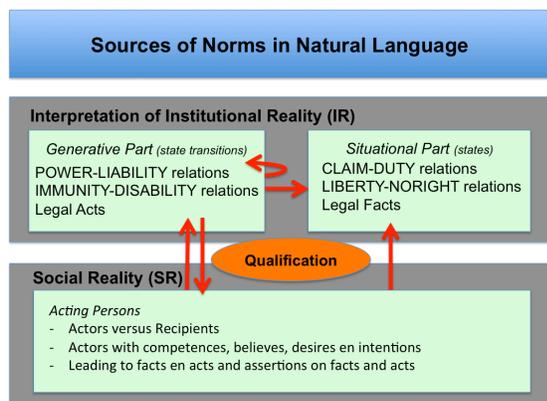


Figure 1. The Three Layers of Reality model.

In order to build a method for describing these three different layers, we have reconceptualized norms and normative systems, allowing us to model and analyze conflicting interpretations and to allow for simulating multiple interpretations in agent-role model based representations of social reality, see Sileno, Boer and Van Engers [17].

In the next section, we will briefly introduce the methods we use for modeling these three layers of reality.

## III. METHODS

### A. Representing sources of law

The way we represent the normative sources is completely according to the state of the art standards (see CEN/Metalex [3]).

### B. Fundamental legal concepts

The method for modeling the institutional content of normative sources is based upon the work of Wesley Newcomb Hohfeld, who introduced a set of fundamental legal conceptions in 1913, see Hohfeld and Cook [10]. Hohfeld’s conceptualization of norms was meant to provide a solution for the ambiguity of the concepts ‘right’ and ‘duty’. Hohfeld introduced a smallest set of legal conceptions to which, according to him, any and all ‘legal quantities’ could be reduced. But while Hohfeld was mainly aiming at understanding the positions between two adversarial parties in law cases, we aim to describe, analyze and understand (the consequences of) normative systems in general. This obviously includes individual cases consisting of two adversarial parties.

Hohfeld distinguished four, what he called Jural, or sometimes Legal, Relations: *Power-Liability* (1), *Immunity-Disability* (2), *Duty-Claimright* (3), *Liberty-Noright* (4). The term Jural Relation is probably chosen because Hohfeld, being a judge and professor in law, was mainly interested in applying his conceptual framework to cases of law in a judicial context. Other authors have chosen to either use the Legal or Jural Relations. Some have mixed these terms in their work, without giving an explanation for the difference between them, see for example [9]. For people in the field of law the terms *legal* and *jural* do have different meanings. We, however do not limit the application of our framework to either *legal* or *jural* norms. We address norms in general, including policies and social norms, therefore we use the term Normative Relations.

The Hohfeldian legal conceptions can only exist in pairs and describe relations between two people, each holding one of the rights in a pair. The *Power-Liability* and *Immunity-Disability* relations are generative: they can generate new Normative Relations. The *Duty-Claimright* and *Liberty-Noright* relations are situational: they can only be created and terminated by an act based on a generative Normative Relation.

### C. Acts and facts

To be able to conceptualize normative systems in general, we express functional relations between complex

objects (i.e., accessibility relations between possible worlds). To be able to do so we use acts and facts that are recognized by an institution: Institutional Acts and Institutional Facts. Institutional Acts play a pivotal role, as these acts connect the worlds in which certain Institutional Facts hold and certain Normative Relations exist. Generative Normative Relations (i.e., *Power-Liability* and *Disability-Immunity*) are expressed in a functional way, having a precondition, and a postcondition.

The formalization of norms stated in sources of norms, expressed in natural language, is being made explicit in an interpretation model derived from the original Hohfeldian framework. The resulting model contains the institutional interpretation of legal norms in a way that can be directly validated by legal experts (1), it can be used as a basis for a comprehensive representation of norms for clients of an institution (2), it is defeasible for clients and their legal representatives (3) and, it can be used to make a specification for IT services to support business processes (4). We have tested the applicability of this approach by modeling examples of various sources of law over the last couple of months and validated the results with experts.

#### D. Agent-base modeling

To model social reality, we have worked on different representation models enabling agent-role modeling and modeling social interaction between agents adapting such agent-roles. Also, various architectures and implementations of agent-role simulation environments have been tested, but as this is still quite preliminary work, in this paper, we will focus on the interpretation of norms from sources of norms, expressed in natural language and representing these in models of Institutional Reality.

#### IV. OUTLINE OF OUR METHOD TO MODEL A FORMAL INTERPRETATION OF SOURCES OF NORMS

Applying Hohfelds conceptualization for formalizing rules has been done before, e.g., by Allen and Saxon [1]. But rather than taking logic as formalization language like Allen and Saxon did, we have made a functional interpretation of the generative Normative Relations. The Institutional Reality model, describing an interpretation of the semantics of the content of the sources taken into scope, consists of two parts. First, the generative part describes the generative Normative Relations, i.e., *Power-Liability* and *Disability-Immunity* relations, as introduced by Hohfeld. Second, the situational part describes the Institutional Facts and situational Normative Relations, i.e., the *Duty-Claimright* and *Liberty-Noright* relations. The Generative Relations are conceptualized as functions with a precondition expressed in terms of Institutional Facts (iFACTs) and Situational Normative Relations, and a postcondition describing which iFACTs and/or Normative Relations are created or terminated. These Normative Relations can be either Situational or Generative Normative Relations. The function can only be executed if an Institutional Act (iACT) is recognized while the precondition is fulfilled.

As a result, we can build a graph of possible worlds, in which certain iFACTs and/or Normative positions hold, and

in which every possible world has exits to other possible worlds that can be reached only by performing Institutional Acts while meeting the required precondition of that act. Institutional reasoning thus becomes a means-ends analysis problem that is commonly used in AI research since the early 1950s. Also, we can use graph analysis (topology) to inspect models of Institutional Reality, we can look for conflicts, missing iFACTs and so on. In this paper, we will focus on the creation of interpretation models, representing institutional reality. We will use a realistic example case from the domain of immigration as an illustration. The case addresses the issue of international students that apply for a study permit in the Netherlands. In the next section, we will explain the case and show interpretation models of the applicable legislation. The interpretation model shown, is actually used for realizing an eService at the Dutch Immigration and Naturalisation service (IND).

#### V. STUDY CASE

Students who do not have the Dutch Nationality and do not have the nationality of a EU Member state, have to apply for a residence permit to be able to study in the Netherlands. The application process for international students is one of the first services in a program that aims to digitalize all IND services. In an effort to support accountable services and agile implementation of policy changes, the IND is working on a formal method for the interpretation of norms. The analysis of the admission of, and the decisions on, applications for residence permits for international students, is one of the study cases used to develop a method for representing a formal interpretation of norms.

##### A. Applying for a residence permit in steps

In order to present our method for formalizing the interpretation of norms, the procedure for applying for a residence permit is described in steps. For every step, a short description of the legal context is given.

An international student that wants to come to the Netherlands has to apply for a residence permit. Applying for a residence permit, results in the creation of a liability for the IND to decide on the application. The liability to decide creates new duties for the IND:

1. When preparing a decision the administrative authority has the duty to acquire the necessary knowledge of relevant facts and of the interests to be weighed.
2. A decision must be based on sound reasoning.
3. A decision must be given within the time limit set by law.

Article 14, Alien Act (AA) gives Our Minister of Justice the power to grant, reject, or to disregard the application for granting a residence permit. Article 16, Alien Act explicitly states 11 grounds to reject an application. Article 4:5 of the General Administrative Law (GAL) gives the procedure of disregarding an application. Article 24, paragraph 2 the Alien Act gives Our Minister the power to disregard an application if no payment for the handling of the application has been made. Article 26 of the Alien Act gives Our Minister the

duty only to grant a residence permit if the applicant fulfills all conditions. As a result the grounds for granting a residence permit can be derived from the absence of grounds to reject or disregard an application.

The relevant norms for the actions described above are described in natural language in sources of law. These sources do not have a functional structure and they include a lot of implicit references.

### B. A formal analysis of norms

The formal analysis of norms requires the explicit description of an initial legal state. This state is the precondition that enables a legal act. Preconditions and legal acts are described in such a way that this act will always result in a one, and only one, postcondition. The postcondition can contain: the creation of new iFACT's and/or Normative Relations (1), and/or the termination of existing iFACT's and/or Normative Relations (2).

### C. Examples of Normative Relations for deciding on applications for residence permits

The study case described above will now be presented in terms of our formal interpretation model. We present two representation formalisms, a vertical one and a graphical notation.

LEGAL SOURCE: Article 4:1 General Administrative Law

TEXT: "The application to issue a decision is submitted in writing to the administrative authority competent to decide on the application, unless otherwise provided by law."

NORMATIVE RELATION: NR.GAL.4:1

iACT: [to submit]

OBJECT: [the application to issue a decision]

POWER: [administrative authority]

LIABILITY: [applicant] (implicit)

PRECONDITION: (iFACT.GAL.4:1.written

[the application to issue a decision is submitted in writing]) AND (iFACT.GAL.4:1.competent [the application is submitted to the administrative authority competent to decide on the application]) AND NOT (iFACT.GAL.4:1.provided [unless otherwise provided by law])

CREATING POSTCONDITION:

(iFACT.GAL.4:1.application [the application to issue a decision]) AND (NR.GAL.3:2 (DUTY: [the administrative authority] | CLAIMRIGHT: [the applicant]) [during the preparation of a decision the administrative authority acquires the necessary information concerning the relevant facts and the interests to be weighed]) AND (NR.GAL.3:46 (DUTY: [the administrative authority] | CLAIMRIGHT: [the applicant]) [a decision must be based on a valid motivation]) AND (NR.GAL.4:13.1.timelimit (DUTY:

[the administrative authority] | CLAIMRIGHT: [the applicant]) [a decision must be given within the time limit set by law])

LEGAL SOURCE: Article 14, first paragraph, point a, Aliens Act

TEXT: "Our Minister is authorized to accept, to reject or to disregard the application for granting a temporary residence permit."

Notice that this sentence contains three acts. As a result the sentence describes three separate NORMATIVE RELATIONS to maintain a functional perspective: granting (1), rejecting (2) and disregarding (3).

1. NORMATIVE RELATION: NR.AA.14.1.a.grant

iACT: [to grant]

OBJECT: [the application for granting a temporary residence permit]

POWER: [Our Minister]

LIABILITY: [the alien]

PRECONDITION: (iFACT.AA.14.1.a.application

[the application to grant a temporary residence permit])

AND (iFACT.AA.26.1.a [the alien has demonstrated that he fulfills all conditions for granting a residence permit])

CREATING POSTCONDITION:

(iFACT.AA.14.1.a.grant [the application to grant a temporary residence permit is disregarded])

TERMINATING POSTCONDITION:

(iFACT.AA.14.1.a.application [the application to grant a temporary residence permit])

2. NORMATIVE RELATION: NR.AA.14.1.a.reject

iACT: to reject

OBJECT: [the application for granting a temporary residence permit]

POWER: [Our Minister]

LIABILITY: [the alien]

PRECONDITION: (iFACT.AA.14.1.a.application

[the application to grant a temporary residence permit])

AND (iFACT.GAL.3:46 [a valid motivation]) AND

(iFACT.GAL.3:4.2 [the adverse consequences of a decision are not disproportionate to goals served by the decision for one or more parties involved])

CREATING POSTCONDITION:

(iFACT.AA.14.1.a.reject [the application to grant a temporary residence permit is rejected])

TERMINATING POSTCONDITION:

(iFACT.AA.14.1.a.application [the application to grant a temporary residence permit]) AND (NR.GAL.3:46

(DUTY: [the administrative authority] | CLAIMRIGHT: [the applicant]) [a decision must be based on a valid motivation])

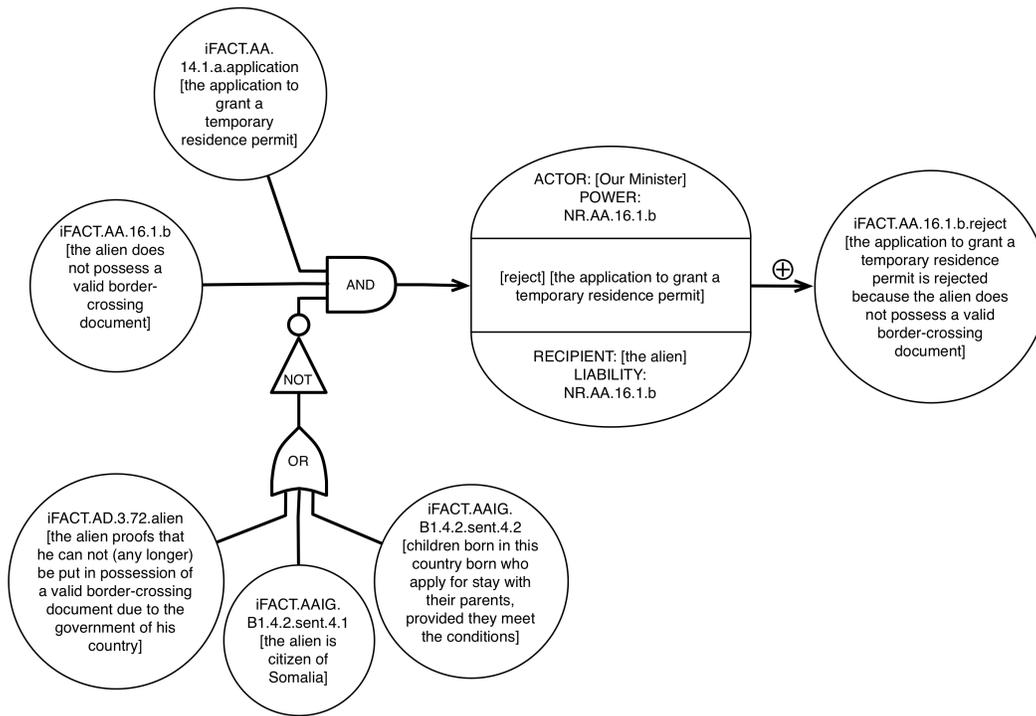


Figure 2. The graphical representation of the Normative Relation described in article 16, paragraph 1, point b of the Aliens Act.

3. NORMATIVE RELATION: NR.AA.14.1.a.disregard  
 iACT: [to disregard]  
 OBJECT: [the application for granting a temporary residence permit]  
 POWER: [Our Minister]  
 LIABILITY: [the alien]  
 PRECONDITION: (iFACT.AA.14.1.a.application [the application to grant a temporary residence permit]) AND (iFACT.AA.24.2.disregarding [if payment is not made, the application will be disregarded])  
 CREATING POSTCONDITION:  
 (iFACT.AA.14.1.a.disregarded [the application to grant a temporary residence permit is disregarded])  
 TERMINATING POSTCONDITION:  
 (iFACT.AA.14.1.a.application [the application to grant a temporary residence permit]) AND (NR.GAL.4:5 (POWER [to disregard] [application]))

LEGAL SOURCE: Article 16, first paragraph, point b, Aliens Act  
 TEXT: “An application to grant a temporary residence permit as referred to in Article 14 may be rejected if:  
 b. the alien does not possess a valid border-crossing document.”

NORMATIVE RELATION: NR.AA.16.1.b  
 iACT: to grant  
 OBJECT: [the application to grant a temporary residence permit]  
 POWER: [Our Minister]  
 LIABILITY: [the alien]  
 PRECONDITION: (iFACT.AA.14.1.a.application [the application to grant a temporary residence permit]) AND (iFACT.AA.16.1.b [the alien does not possess a valid border-crossing document]) AND NOT ((iFACT.AD.3.72.vreemdeling [the alien proves that he can not (any longer) be put in possession of a valid border-crossing document due to the government of his country]) OR (iFACT.AAIG.B1.4.1.sent.4.1 [the alien is citizen of Somalia]) OR (iFACT.AAIG.B1.4.1.sent.4.2 [children born in this country born who apply for stay with their parents, provided they meet the conditions]))  
 CREATING POSTCONDITION:  
 (iFACT.AA.16.1.b.reject [the application to grant a temporary residence permit is rejected because the alien does not possess a valid border-crossing document])  
 Figure 2 gives the graphical representation of Normative Relation NR.AA.16.1.b.

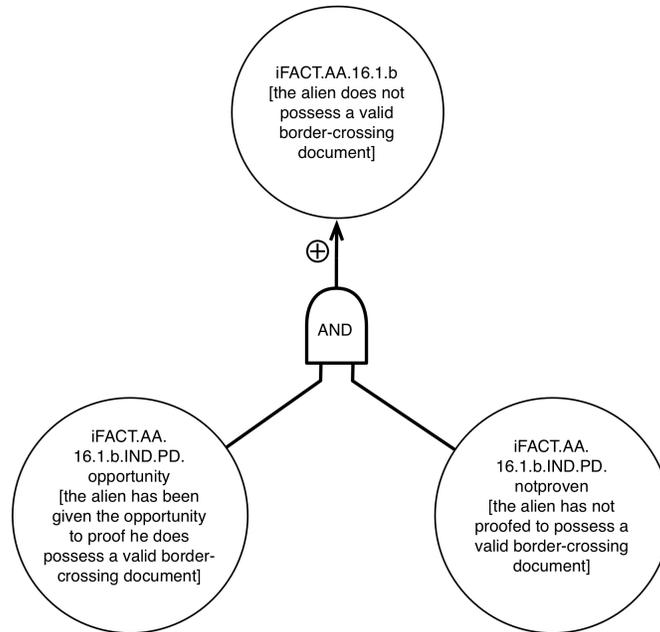


Figure 3. The graphical representation of de derivation of creation of iFACT.AA.16.1.b: ‘the alien does not possess a valid border-crossing document.

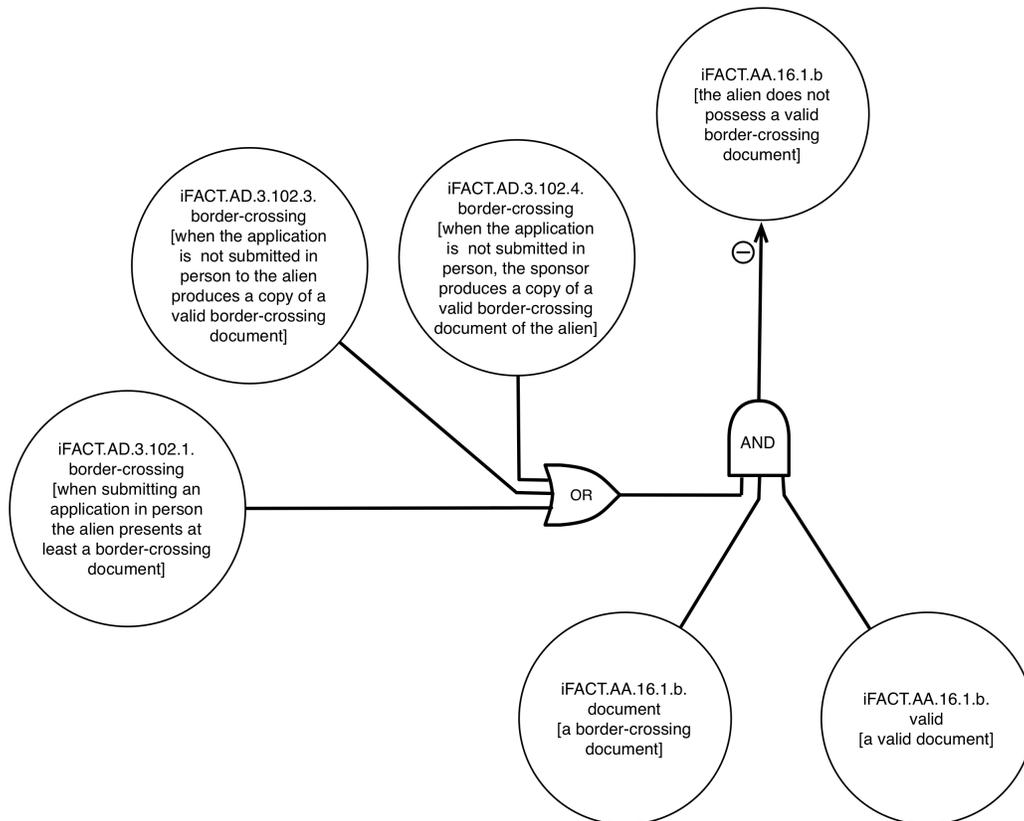


Figure 4. The graphical representation of the termination of iFACT.AA.16.1.b: ‘the alien does not possess a valid border-crossing document.

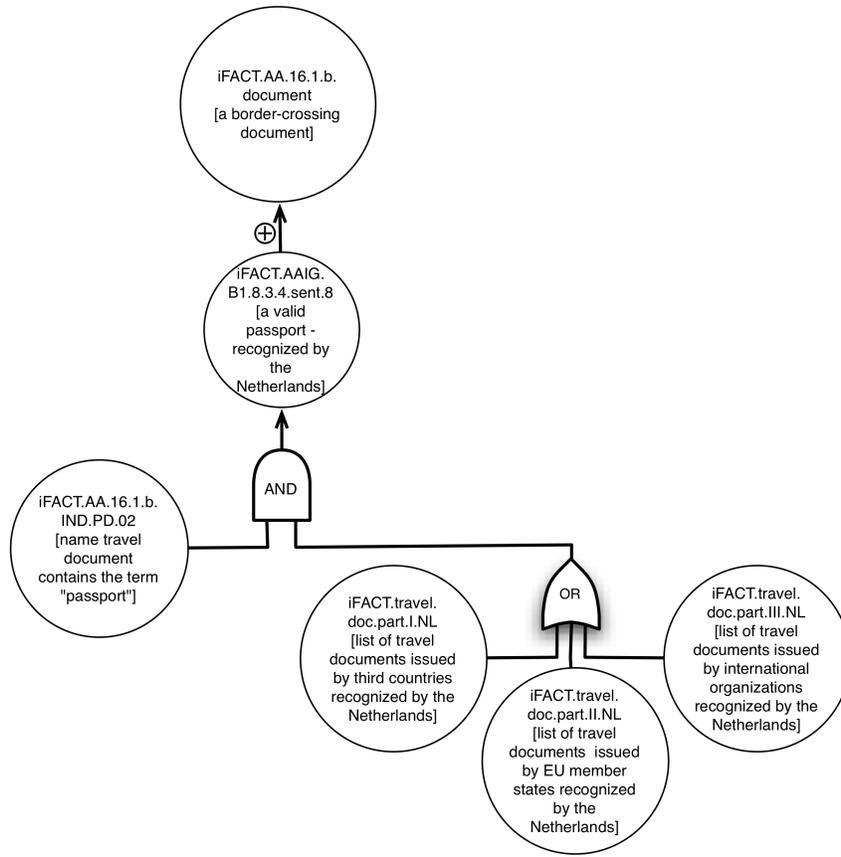


Figure 5. The graphical representation of the inconclusive policy decisions on traveldocuments that are not a ‘passport’.

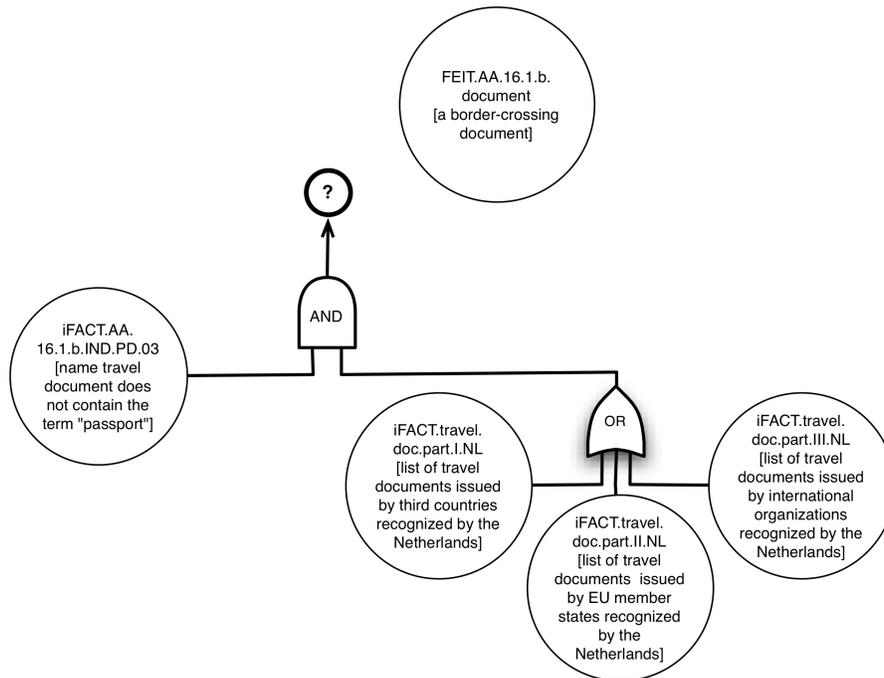


Figure 6. The graphical representation of the inconclusive policy decisions on traveldocuments that are not a ‘passport’.

#### D. Establishing the existence or non-existence of iFACT's

The Normative Relations described above are practical because:

1. They can be traced back to specific words in legal sources.
2. They give an overview on the condition under which an iACT has a legal status and on exemptions.
3. The effect of the iACT is fully described, making it possible to formally describe the postcondition of the act.

However, the question what it takes for an iFACT to exist, or not, is still unclear. To answer this question a notation for deriving iFACTs, is developed. The derivation of iFACTs should be backed by legal sources or by policy statements. This can be illustrated by the derivation of the existence of iFACT.AA.16.1.b: [the alien does not possess a valid border-crossing document].

To be able to derive the existence or non-existence of iFACT.AA.16.1.b the following questions must be answered:

1. What is a border-crossing document?
2. What determines the validity of a border-crossing document?
3. How can an alien prove he possesses a border-crossing document?

Figure 3 shows the graphical representation of the derivation of the creation of the iFACT.AA.16.1.b. Figure 3 contains the concepts iFACT.16.1.b.IND.PD.opportunity and iFACT.16.1.b.IND.PD.notproven. These iFACTs represent policy decisions (PD) that do not yet exist, but are a formalization of the common knowledge procedure followed by IND employees to derive iFACT.AA.16.1.b [the alien does not possess a valid border-crossing document]. The question whether iFACT.AA.16.1.b.IND.PD.opportunity and iFACT.AA.16.1.b.IND.PD.notproven should be formally established as IND implementation guidelines, is not yet answered.

Figure 4 shows the graphical representation of the derivation of the termination of iFACT.AA.16.1.b. It contains a breakdown of the sentence 'the alien does not possess a valid border-crossing document' into three parts: the document is 'a document belonging to the alien' (1), the document is 'a border-crossing document' (2) and the document is 'a valid document' (3).

Article 3.102 Aliens Decree (AD) gives three possibilities for the alien to prove he possesses a valid border-crossing document.

Figures 5 and 6 show the derivation of answer to the question what is 'a border-crossing document'. Figure 5 shows that any document that is a travel document recognized by the Netherlands, which contains the term 'passport' is considered to be a border-crossing document, based on Aliens Act Implementation Guidelines (AAIG) Volume B1, Chapter 8, paragraph 3.4, sentence 8. The list of travel documents recognized by the Netherlands can be

found in three lists that are published under the authority of the European Commission. Figure 6 shows that the question whether a travel document that is recognized by the Netherlands and that does not contain the term 'passport' can not be answered based on sources of norms. Answering this question is, at present, left to the discretionary powers of IND officials.

Of all the aliens possessing a travel document and applying for a residence permit, more than 99% possesses a passport. In special situations, aliens possess a travel document that is not a passport – i.e., a refugee document or a seamen's book. To decide whether these travel documents are border-crossing documents, contextual information will be taken into account. For example: a seamen's book will probably not be accepted as a border-crossing document for an international student, because fulfilling the conditions for residing as an international student implies that the alien will leave the ship to study and doing so he will lose his valid seamen's book. The official will probably ask for a passport as proof for the possession of a valid border-crossing document. But this norm is not explicitly written down, probably because it concerns a situation that does not occur or is extremely rare.

## VI. RESULTS

The method presented has been tested by analyzing regulations relevant for application of residence permits for foreign students and making decisions on these applications. The results are being used in the Digital Service Program of the IND that aims to have digitalized all IND services in 2017.

The analysis resulted in knowledge representations of legal knowledge that proved to be comprehensible for multidisciplinary teams consisting of legal experts, policy advisors, administrators, knowledge workers and IT-experts (1), a list of anomalies in sources of law (2), specifications for executable knowledge models traceable to sources of law for inference engines (3), reusable components for specifications of related services (4).

### A. Comprehensible representation of Normative Relations

Being able to validate the interpretation of norms with experts is an essential requirement of a formal method for the interpretation of norms in natural language. We have tested the comprehensiveness of the representations in sessions with legal domain experts and policy advisors. Legal experts and policy advisors considered the representation of norms in a functional perspective by determining a unique postcondition for an iACT, performed in an explicit precondition useful. They understood the interpretation models without training and only needed some additional explanation. In some cases the models even caused changes in interpretations these experts acquired based on the sources of norms in natural language. Quantitative information on the validation of models is not yet available. Also autonomous validation of legal experts without support, has not yet been tested. The first experiences suggest that autonomous validation is possible for legal experts that received some training using the method.

### B. Anomalies in sources of law

Making an explicit interpretative model exposed anomalies in sources of law that, until now, remained undetected. The most important anomalies found are:

1. Mistakes in the registration of changes in sources of law. This results in faults in punctuation and in the adequate processing of changed references due to changes in sources of law. In article 16, paragraph 1, point e. we found a reference to the Infectious Diseases Act, that was replaced by the Public Health Act in 2008. The list of purposes of stay in article 3.4 Alien Decree (study is mentioned under point 1.) refers to article 14, paragraph 2, Alien Act. Since a new paragraph 2 was introduced on June first 2013 the reference should have been changed to paragraph 3.
2. Incorrect interpretations due to multiple step implicit references. An example of this is the legal basis for accepting scholarships as independent means of support for students. The implementation guideline on which the power to recognize a scholarship as independent means of support refers to article 3.22 Alien Regulation that deals with sustainability. As a result there is no legal basis for accepting scholarships as means of support for students.

In current practice substantial investments in time and efforts are being made in order to detect and repair anomalies. Despite these efforts many anomalies remain undetected due to the lack of a proper method for interpreting sources of law, like the one presented in this paper.

These anomalies result in ambiguous implicit interpretations, which may lead to incorrect judgments of cases. Incorrect judgements may lead to expensive lawsuits.

## VII. DISCUSSION AND CONCLUSION

In [7], we described the scoping process that would enable us to efficiently work our way through the voluminous sources of norms. We discovered that the detailed modeling of the content of these sources helped us to discover 'lose ends', i.e., missing parts in these sources explaining essential things we needed to understand the meaning of the norms or the context in which those norms could/should be applied. Also, we discovered flaws in the referential structure of those sources.

The method presented in this paper, enabled us to make the interpretation of sources of norms, expressed in natural language, explicit. Domain experts, both legal experts and policy advisors, could not only work with those models, they were able to validate them and used them to start repairing the anomalies presented in Section 4 on the results of our analysis.

The method described in this paper, fits within a framework that also includes structuring sources of norms and modeling Social Reality. It is our aim to be able to understand how people understand norms, how we reason

about them and how norms affect our society. The model of Institutional Reality is just a small step towards a better understanding of norms governed societies.

It is within our aims to set-up an ecological system where the agencies responsible for implementing regulations will make their models available to who ever wants to incorporate them in systems that are designed for other purposes. We have tested this with one of our master students, see [11], who has build a tax planning application for one of the big accountancy firms in the Netherlands, using an interpretation model that was made with help of the Dutch Tax Administration. This application, that was the result of a master thesis research project, of course was limited to a small piece of legislation, international Value Added Tax. But it showed that such an ecosystem is viable. To develop such an ecosystem is future work.

With this paper we hope to contribute to society, by allowing governmental agencies, non-governmental organizations and citizens to understand how norms are interpreted. This will also allow us to exchange ideas about solving conflicts in a civilized way, in case different opinions exist on the interpretation of sources of norms. Furthermore, it helps us to understand how one derives a different conclusion of the same set of facts, using a different interpretation model.

This brings us to the next topic, the role of the models of Social Reality that we develop using agent-role models. In most cases norms are created within a context where the people creating them have the power to enforce these norms, at least to a certain extend. It was outside the scope of this paper to discuss reward and punishments as instruments to promote certain behavior and discourage other. However if one creates norms, one would expect that these norms affect society in some way. In practical situations, e.g., in the field of law making, one would expect law-makers first to think well about the consequences of norms, before imposing them upon society. Nowadays, we have the computer power to actually simulate the effects of norms on society. The interpretation models of sources of norms described in this paper, play a pivotal role in creating the agent-role based simulations that we can develop to reason about the effects of norms in social reality.

The method presented in this paper, has been tested in a governmental organization for the specification of digital services. Also, we have applied it in other, smaller domains. Further application is planned, and we hope to learn from the experience with it. We have also planned to report on coder-dependencies and natural language processing to support our method, similar to the work of De Maat [12][13][14], in the near future.

The method presented in this paper, preserves the original legal concepts described in natural language in sources of law, and delivers a formal translation of the norms contained in sources of law. This gives us a good basis for improving the agility of governmental agencies and others that use IT systems impacted by norms. At this stage we cannot give any numbers, but it would be interesting to measure the effect of using normative interpretation models for the explicit specification of actions by employees or

requirements for IT-solutions in comparison to existing practices.

As for now, we have created a way to produce models that explicitly describe the interpretation of sources of norms, models that support institutional reasoning, i.e., reasoning about Institutional Facts and legal positions, and accounting for the reasoning.

In the future we will continue our work on completing our method. Constructing components that will allow us to simulate scenarios in social reality are amongst the new developments planned. We will also extend the domains in which we will test the usability of the current parts of our method. Foreseen extensions are in the field of tax administration, labor law (regulating flexible working hours in employment relations). Furthermore, we will work on the development of IT support for our method in co-operation with governmental organizations, businesses and the scientific community.

Our quest continues. In the spirit of Leibniz, who once dreamt of creating a calculus to solve disputes between people, we dream of offering the tools that help us to better understand the mechanisms of interpreting norms and settle disputes about them, thus keeping our society a civilized one.

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