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# Connecting People: Semantic-Conceptual Modeling for Laws and Regulations

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**Abstract.** Working on building large scale information systems that have the job to serve their clients in a client friendly way and at the same time have to comply with the rules that regulate their behavior, including their (legal) decision-making processes, we observed that designing these systems is still more an art rather than a result of systematic engineering. We have been working on a method allowing stakeholders to systematically analyze the rules and their meaning (i.e. their effect in practical cases) in such way that it supports systems designers and (legal) experts in making sense out of the legal sources, and use this understanding of the regulatory system at hand when designing information systems that supports both the (administrative) organizations and their clients. In this paper we will elaborate on our proposed analysis approach, show how to systematically use the patterns explicitly but often implicitly available in laws and regulation. The Hohfeld conceptual model is very helpful. The Hohfeld model needs extension in our view and thus we have specified the semantic-conceptual model for Hohfeld as a solid base to add time travel aspects.

**Keywords:** Formal model of Hohfeld legal relations; analysis of law constructs; law based large scale information systems; temporal extension of Hohfeld; semantic-conceptual model; legal DNA

## 1 Introduction

Most governmental institutions, including public administrations, are aware of the fact that the services they provide to citizens and companies, are primarily defined in laws, decrees and other regulations, collectively here referred to as the law. However if you look at the way they bring about these services and design the (e-)forms and (web) IT-services this clear connection between these services and some legal source defining them seems to be completely missing in nearly all cases. This lack of transparent connection between the legal sources and IT-systems will lead to increased complexity and high maintenance costs and decreased adaptivity when changes in policy or circumstances require it.

Dealing with change is something public administrations normally can handle very well as they are used to ever changing regulations and keeping their systems aligned with their environments. However the way most administrations handle this can be

characterized as an art rather than following a rational engineering approach. This is surprising given the interest of the process and amount of effort and money involved in it. What we observed in the more than 30 years working experience in business information systems, is that different stakeholders within the public administrations try to grasp the consequences of the regulatory or environmental changes for those issues they feel responsible for and then start to redesign the processes, (parts of) IT-systems, (e-)forms etc., without worrying too much that the partial solutions will together create the required, i.e. compliant, solution. As a result of this existing practice administrations can not guarantee the legitimacy of their acting, have difficulties explaining their (legal) decisions, deliver not always the services expected by their stakeholders, and are less adaptive and cost-effective as they could be.

In one of our previous publications (Van Engers & Nijssen 2014a) we have described part of our modeling approach, more specifically an analysis of legal relations, an analysis that is based upon the original work of Wesley Newcomb Hohfeld (see Hohfeld 2010, originally published 1913). We have extended the four basic relational categories with temporal relations and explicit events (legal actions) that allow us to analyze and describe regulations and situations subjected to regulations using a state-transactional view fitting the life-cycle of these legal relations and enabling for a service-oriented perspective combining the requirements from regulatory sources and the life events of the cases at hand.

Before introducing the Hohfeldian basic categories and explaining our extensions, let us explain some of the considerations we had when we started our quest for a semantic-conceptual modeling method for laws and regulations that would be the basis of an engineering approach for large-scale information systems in (public) administrations.

One of these considerations was that policymakers and legal drafters tend to limit their creativity by (re)using existing policies and regulations as examples. Mechanisms such as good drafting principles (in many countries the drafters are bound by these principles, in the Netherlands for example by the “Aanwijzingen voor de Reggeving” in English “Directives for the Legal drafter”) further limit the number of constructions the policymakers and drafters will produce when creating new regulations or change existing ones.

The operational units that are responsible for organizing the processes that make the regulations work also restrict themselves by basing the new functionalities that are implied by the new regulations on ones that are already known. This allows the administrations to keep close to existing or at least familiar processes with the assumption of a decrease in failure risks. In our many years of working in practice however we have not seen this reuse of abstract building blocks explicitly addressed, while we were more and more convinced this would allow us to build better information systems. These systems of course would primarily have to be correct implementations of the requirements that are given by laws and regulations.

## 2 Public administrations and (public) service design

From public administrations we expect that their activities and information systems supporting them, i.e. the administration's services, are derived from law. Not implementing services that would be required to fulfill legal obligations or allow citizens to execute their rights would disrupt our legal systems while offering services that are not connected to the law would rightfully be considered a waste of public money at least. In practice however, as far as we know, no method was used to systematically analyze sources of law and derive the required services in such way that the connection would be clear to all stakeholders. In 2012 in the Netherlands some public administrations together with universities and innovative companies of prime interest for e-government started to cooperate on these matters. The authors of this paper are member of that cooperation. We named this group the 'Blue Chamber' referring to the color of the walls of the room in which the first concrete ideas have taken shape. The authors of this focus on the fundamental research work in this groups' co-creative effort and report in this paper part of what they have accomplished.

As stated before our approach is partly based upon work of Hohfeld, who developed his legal relations in the early twentieth century. One could wonder why it takes so long to develop a method that would guarantee the correct implementation of law. Perhaps the most recent crisis in the Netherlands is a blessing in disguise forcing public administration to do more with less. The people representing the public administrations stressed that the conditions under which the government must perform its duties are constantly changing due to changes in legislation. The effects of these changes are to be implemented in services to citizens and businesses quickly and effectively. Citizens and businesses may expect reliable and expedient rendering of services. Obviously these services should provide answers to their questions, or offer a solution to their specific needs.

In recent decades, public administration has changed under the influence of digitisation. These changes affect the processes of implementing public services. Both the large-scale processes for handling cases of large groups of citizens, and processes for the treatment of individual cases in complex situations are affected. Examples can be found in the area of benefit provision, granting of subsidies, licensing and taxation. Central government, provincial governments and municipalities strive, as much as possible, to process applications for licenses, benefits and the provision of other public services electronically.

Successive governments have been working on a response to this development. Among other things, this has resulted in a government-wide vision<sup>1</sup> of the provision of services to citizens and businesses. This vision is based on customer-driven public services in which there is a central focus on the requests of citizens and businesses. The implementing bodies are expected to design their processes and services in such a way that they can meet the needs and perspectives of their customers. In other words, efficacy is central. A prime challenge will be to offer the desired effective processing of customer requests in an affordable and efficient manner.

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<sup>1</sup> Established Government-Wide Vision of Services (Vastgestelde Overheidsbrede Visie op Dienstverlening) kst-26643-182 – Official Publications (in Dutch)

The effective and efficient handling of customer requests requires cooperation between different organisations. This helps diminish the meaning of the boundaries between layers of government and government organisations.

In order to play their part for and on behalf of citizens, it is necessary for the government organisations to design their processes and services in such a way that they can respond to changing conditions, changing stakeholder demands and changes in cooperation with other organisations.

In recent years, it has been the tendency for implementing bodies to refrain from concealing the rules in layers of IT systems, but to opt instead for an approach in which these rules are defined in such a way in IT systems that they can be more easily implemented and maintained. In legislation, the trend is to model information, rules and processes in an integrated fashion. This translation of legislation into integrated knowledge and process models is used as a specification for processes and IT systems. 'Rule-based or knowledge-based working', 'rule management', 'Knowledge as a Service' (KaaS) and 'agile implementation of legislation' are names that are used to describe this approach.

The approach aims to provide greater flexibility and agility in the implementation of new laws and/or regulations.

What is still lacking however is a uniform and coherent method to analyze and interpret sources of law that would achieve integrated information, rules and process models with which the desired flexibility and agility in the provision of information can be realized. Such an approach is therefore a prerequisite for the realization of a customer-oriented service and for securing collaboration between organizations (interoperability). The observations below from daily implementation practice illustrate the lack of a 'clear and coherent method of analysis for the interpretation of legislation by implementing bodies':

- Translating legislation into customer-driven service and product requirements for the implementation of processes and applications is usually quite time-consuming.
- The (contents of) services and processes are not sufficiently traceable to the legislation.
- Up till now, the translation of legislation into service and product requirements has often proved to be a process difficult to control. The procedure is not clear and is in part implied and depends on the individual 'translator'. Analysis usually takes place from this translator's own discipline (legal, implementation, information science or IT). The required expertise is scarce.
- Adequate support which allows for intelligent searching of the corpus of legislation is currently lacking and there is only limited support for adequately managing the results in conjunction.

It is our aim to help to solve these issues by developing the required method.

In that effort it was clear from day one that we had to clarify the meaning of the legal sources, i.e. the effects that it could potentially have for each of the addressees, first. A semantic-conceptual model of the legal source could create this required clarity. When developing our method we were primarily asking ourselves which are the kind of constructs that are required in the semantic-conceptual model such that the intent of the law can be maximally explicitly represented in a scalable semantic-conceptual model?

Regulations, for example a law, describe primarily the rights and duties of the parties with respect to certain matter. Rights and duties are terms that upon semantic-conceptual analysis can be usefully subcategorized. About a century ago Hohfeld described a solid framework for this subcategorization. His description however was – understandably at that time (1913) – reasonably informal and also it lacked some elements that would allow us to formally express the meaning of regulatory sources in such a way that it would fit our current needs.

In the next sections we will describe the formal semantic-conceptual model of that framework as a base to add requirements that have originated in more recent years.

### 3 The original Hohfeldian relations

Wesley Newcomb Hohfeld produced a landmark paper in the early years of the 20th century, clarifying the most important concept in the legal world: the legal relation (Hohfeld used both the terms legal as well as jural relation). One of Hohfeld's main ideas is that all legal relations consist of a set of atomic or elementary legal relations between two parties with respect to a certain matter, and each legal relation has only the following four possible pairs:

- i. One party has a **right** (claim) and another party has a **duty**,
- ii. One party has a **privilege** and another party has a **noright**,
- iii. One party has a **power** and another party has a **liability**, and
- iv. One party has an **immunity** and another party has a **disability**.

In Van Engers & Nijssen (2014a) we have paraphrased Corbin (see Corbin 1991 & 1921) and have posed the following about these four party-paired legal relations:

Suppose we have two parties, person A and person B.

**Right and duty.** When person A currently has a right and person B has at the same time a duty with respect to matter M, person A is aware that the following holds: what must person B do for me (person A) with respect to matter M; person B is aware that for him the following holds: what must I (person B) do for person A with respect to matter M?

**Privilege and noright.** When person A currently has a privilege and person B has at the same time a noright with respect to matter M, person A is aware that the following holds: what may I do with respect to M, without having regard for any other including person B; the noright party, in this case person B is aware that for him the following holds: what may person A do with respect to M, unrestrained by me (person B)?

**Power and liability.** When person A currently has a power and person B has at the same time a liability with respect to matter M, person A is aware that the following holds: what new legal relation may I create between person B or

between person B and another party, or me, with respect to M; the liability party, in this case person B is aware that for him the following holds: what new legal relation may person A create for me and another party with respect to M, without having any regard for my position?

**Immunity and disability.** When person A currently has an immunity and person B has at the same time a disability with respect to matter M, person A is aware that the following holds: with respect to matter M person A is not subject to the power of person B to alter the legal relation of person A with respect to matter M (paraphrasing Corbin 1919, page 8). The disability party, in this case person B is aware that for him the following holds: person B cannot change the existing legal relation of person A with respect to matter M.

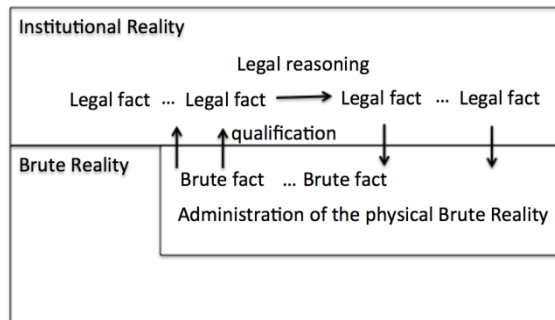
In Van Engers and Nijssen 2014 we have pointed at one of the major issues with Hohfeld's original work; it lacks a temporal perspective which is needed to understand how acts are related to the creation and termination of legal relations (typically created via a power-liability). Such perspective is essential for connecting the legal consequences to the acts performed, a perspective we need to when we want to build supporting IT systems. These IT systems after all will have to handle complex social situations and consequently we need to understand the sequences of actions that we have to be able support, by creating services for each of them. The power for every alien to receive asylum, for example, can be expressed as a power-liability relation, requiring a service to submit these requests and a service to inform the alien about the result of processing that request. In our method we therefore have include a temporal perspective, which allows us to understand the consequences of the creation and termination of Hohfeldian relations.

#### **4 A service oriented design perspective on Hohfeld**

In the previous section we have already pointed at one of the shortcomings of Hohfeldian analysis, i.e. the lack of an explicit temporal perspective. Another weakness is its mere focus on the institutional reality layer leaving the connection to brute reality underexposed. Figure 1 shows the connection between these layers.

Legal reasoning is part of the Institutional Reality layer. This Institutional Reality layer maps legal facts, using legal rules, to other legal facts. In other words it describes legal facts and legal (derivation) rules. Furthermore it describes legal meta-rules, such as rules that determine the applicability of other legal rules. The legal facts in the Institutional Reality layer have to be connected to the brute reality. Brute reality consists of the physical and informational or administrative brute reality. The brute facts represented as some data object can be 'qualified' or 'count as' some legal fact. Therefore (institutional) meaning is assigned to the brute facts through their qualification. It must be noted that in most court cases it is the qualification of brute facts that are disputed rather than the epistemic reasoning (i.e. drawing conclusions from legal facts and the applied legal rules). Intuitively one would think that each brute fact

could be classified into one of two classes: legally relevant and legally irrelevant. However it is slightly more complex than this. One brute fact may be irrelevant from a certain perspective, such as the price of a car is irrelevant from the perspective of the traffic code, but might be relevant for some other perspective, like tax law. The specification of a semantic-conceptual model can help in detecting consequences of possible qualifications of disputed facts.



**Fig. 1.** Institutional Reality and Brute Reality. Legal reasoning with Institutional Reality maps legal facts to other legal facts. These legal facts are connected to the administration of brute reality (i.e. data representation of the physical world) by a process called qualification. This qualification gives (institutional) meaning to the brute facts, it defines what brute facts ‘counts as’ what legal facts.

The policy-makers and legislation drafters that create the regulatory sources, i.e. sources of law, expect that all relevant stakeholders are able to understand the meaning of the institutions described in those sources. This is because the stakeholders are supposed to understand the institutional consequences of their behavior (acts) given some qualification.

Acts performed in brute reality may have legal effects depending on their qualification. Some are qualified as the creation of a liability or the execution of a power thus creating legal relations in the institutional layer; others are qualified as failing to meet a duty and might result in a legal fact that provides the motive for someone to act upon it in brute reality. It must be noted that also not acting in some cases may have legal consequences (negligence).

Hohfeld’s legal relations are always relations between two actor-roles, the buyer and seller, the taxpayer and tax inspector etc. From an organizational or information systems perspective this provides us with a nice demarcation of the internal and the external world. So we could for example describe all relations in the institutional reality in scope from the perspective of one actor-role, e.g. our minister, the tax inspector etc.. Since it are the execution of powers or the imposition of a duty that make others to act (consequence of the power-liability relation), the power-liability relations or the right-duty relations can force us to deliver a service, while allowing for the execution of a power obviously also can be seen as a service.

Combining this perspective selection, taking the position of one of the addressed actor-roles, with the power-liability focus provides us a service-oriented perspective on the legal domain at hand. Let us illustrate this with an example. Let’s assume that a taxpayer has the power to request for a delayed payment given some conditions and



that the tax inspector has the corresponding liability, and the associated duty when the power is executed, to handle the request. The consequent services the tax administration (assuming that the tax administration is the organization that implements the institutional concept ‘tax inspector’) has to provide are ‘reception of delayed payment request’ and ‘provide decision on delayed payment request’. Please note that the production of the decision is the execution of another power by the tax inspector. It must be stressed that liability of the tax inspector doesn’t include a positive decision, i.e. granting of the request. Furthermore, but this would require some legal background knowledge if we would have known that within administrative law one can usually object against decisions, we may need another service ‘receive objection against decision on delayed payment request’, which can be derived from the power of the requestor and liability of the tax inspector.

These services are the constructive components or building blocks that together form our information systems. The input thereof is data that may represent acts and brute facts allowing us to interpret this data and use it for (automated) legal reasoning. The legal consequences can in return be presented as output data of the system. Obviously we might want to present the reasoning (perhaps in reasoning steps) and the intermediary or derived legal facts as well.

## 5. Hohfeld in a semantic-conceptual model

At the time Hohfeld published his landmark paper in 1913 little attention was paid to formal models. At that time there were no large information systems supporting government services. And at that time there was much less experience with diagrammatic representation of knowledge compared with today. If we recall that the first attempt of the now well-known periodic table started in 1789 and the current form was designed in 1923, then it is about time that we start to develop a “periodic table” for legal relations. Hohfeld laid a solid foundation in 1913. How should such a “jural periodic table” look like? We do not pretend we have the final answer but we believe a modest start is described hereafter.

What is a semantic-conceptual model? It is a formal model that:

1. Defines the scope of the subject. This is represented by explicitly defining the fact types aka kind of facts and by consequence the fact instances that are considered within scope;
2. Defines the associated derivation rules, if applicable. Derivation rules map fact sets to other fact sets, and can be interpreted as possible and permitted transitions of fact sets; derivation rules are performed by software;
3. Defines all the associated integrity rules. Integrity rules specify which fact sets within scope and transitions to new sets as a consequence of adding to and/or deleting facts from the fact base as well as mappings between fact sets, i.e. transitions, are considered to be correct expressions; in more casual terms, the integrity rules specify the required quality of the fact sets and transitions. The integrity rules constitute what is usually referred to as the theoretical framework; integrity rules are checked by software;

4. Defines the associated behavioural rules, if applicable and the associated actor-roles; behavioral rules are performed by legal entities;
5. Defines the associated set of events (either jural actions by actors or time-induced events) and
6. Describes the definitions of the terms in natural language.

Please note that 1. through 5. constitute a formal semantic-conceptual model. The item under 6. is an informal component.

The question may be asked: Why do we need the informal component associated with 1. through 5.? To answer that question we need to go through the procedure how to model a law. The source of a semantic-conceptual model is the law and associated decrees, or treaties and regulations. The process that is used to produce a formal semantic-conceptual model for the law is a human process. A lot of essential model elements are implicit in a law. When humans are aware of the patterns containing implicit components as well as the explicit components, duly educated experts can produce a formal semantic-conceptual model. However for humans to do this job, including validation of the model, the definitions of the terms are an absolute prerequisite. Without these definitions there is hardly any chance that the model can be validated. Hence the list of terms and their definition is an indispensable part of the entire analysis and validation process, used to specify a semantic-conceptual model of a law and associated regulations.

A reasoner does, at first sight, not need the list of definitions. The reasoner can produce the results solely from the formal semantic-conceptual model and the fact base. However when a reasoner wants to communicate in a human friendly way, we recommend to make systematic use of this list. Hence there is a useful function for the list of definitions when the entire process is considered.

How is the scope of Hohfeld defined?

The first fact type is:

FT1: <Party-Right-Side> in the role of <Kind-Of-Right> has a legal relation with <Party-Duty-Side> in the role of <Kind-Of-Duty> with respect to <Matter>.

In Fig. 2 we see that within the scope of Hohfeld there are facts that conform to the fact type called “Legal relation”. The fact type “Legal relation” consists of 5 variables. An example of a fact (instance) could be: A in the role of Claim has a legal relation with B in the role of Duty with respect to M. In practice there are millions of these fact instances that are within scope. The semantic-conceptual model declares such fact instances within scope of Hohfeld by the declaration of the fact type “Legal relation”.

With this declaration we can express every Hohfeld legal relation. We want to remark that we recommend to explicitly model Matter as this is a domain specific set of facts.

In the CogNIAM protocol to develop a semantic-conceptual model, there is a rule that specifies that the modeler needs to have at least one functional integrity rule for every fact type. It is recommended to add this type of integrity rule with priority 1.

Integrity rule IR1: The combination of Party-Right-Side, Kind-Of-Right, Party-Duty-Side and Matter is unique.

An alternative formulation could be: The combination Party-Right-Side, Kind-Of-Right, Party-Duty-Side and Matter determines Kind-Of-Duty.

A fact instance of fact type FT1 is an instance of what Hohfeld called a legal relation. At the time of Hohfeld (1913) this was considered sufficient.

In these days (2014) where the government offers services based on laws and regulations, and a very typical characteristic of such laws and regulations is that they are almost constantly changing, we need more extended facts.

FT2: <Party-Right-Side> in the role of <Kind-Of-Right> has a legal relation with <Party-Duty-Side> in the role of <Kind-Of-Duty> with respect to <Matter>. This legal relation was established on <Date-Time-Established>, it starts to become effective on <Date-Time-Effectiveness-Start> and it has terminated respectively is supposed to end its effectiveness on <Date-Time-Effectiveness-Ended>.

But there are several integrity rules in the extended Hohfeld version needed in these days.

We first and for all have to cater for the “time travel” aspect. This means that we have to extend integrity rule IR1 as follows:

Integrity rule IR2: The combination of Party-Right-Side, Kind-Of-Right, Party-Duty-Side>, Matter and Date-Time-Validity-Start is unique.

There are precisely 4 kinds of rights in the Hohfeld approach. Hence we need a fact type and an integrity rule to express that formally. The fact type is:

TF3: Within the collection of kinds of rights there exist the <Kind-Of-Right>.

As we have limited space in this paper we will not include the complete diagrammatic representation of every fact type and integrity rule mentioned below.

Integrity rule IR4: Permitted values for Kind-Of-Right are {claim, privilege, power, immunity}. In a more casual language, Hohfeld recognizes the following kinds of rights: claim, privilege, power and immunity.

If we apply dimension analysis to the kinds of rights we come to the conclusion that we are dealing with two different subtypes:

ST1: Kind-Of-Right-State is a subtype of Kind-Of-Right

Integrity rule IR6: Kind-Of-Right-State permitted values are Claim and Privilege.

ST2: Kind-Of-Right-Dynamic is a subtype of Kind-Of-Right

Integrity rule IR8: Kind-Of-Right-Dynamic permitted values are Power and Immunity.

There are precisely 4 kinds of duties in the Hohfeld approach. Hence we need a fact type and an integrity rule to express that formally. The fact type is:

TF4: Within the collection of kinds of duties there exist the <Kind-Of-Duty>.

Integrity rule IR10 Permitted values for Kind-Of-Duty are {duty, noright, liability, disability}.

If we apply dimension analysis we come to the conclusion that we are dealing with two different subtypes of Kind-Of-Duty:

ST3: Kind-Of-Duty-State is a subtype of Kind-Of-Duty.

Integrity rule IR12: Kind-Of-Duty-State permitted values Duty and Noright.

ST4: Kind-Of-Duty-Dynamic is a subtype of Kind-Of-Duty.

Integrity rule IR14: Kind-Of-Duty-Dynamic permitted values Liability and Disability.

However Hohfeld has made it clear that he only considers the following pairs to be applicable:

FT5: <Kind-Of-Right> and <Kind-of-Duty> is a permitted kind of legal relation.

An alternative formulation could be: The combination <Kind-Of-Right>, <Kind-Of-Duty> is permitted.

Integrity rule IR16: In FT5 the following combinations are permitted {<Claim, Duty>, <Privilege-Noright>, <Power, Liability>, <Immunity, Disability>}

Integrity rule IR18: The combination of <Kind-Of-Right> and <Kind-Of-Duty> in FT2 is a subset of the combination of <Kind-Of-Right>, <Kind-Of-Duty> in FT5.

With the above declarations we see in the diagram at page ... that every legal relation has to have a couple that is permitted.

The Hohfeld model is fairly rich in casually defined integrity rules. To illustrate some of these we decided to confine ourselves to powers and immunities. We derive specialised fact types from the Hohfeld legal relation fact type to make the illustration more clear. In the fact type Power legal relation we have a fact type with three variables, derived from the fact type Legal relation. See Fig. 2. We can now formally model all the rules that Hohfeld formulated informally. The exclusion integrity rule exc4001 specifies that a given party on the right side and a given party on the duty side with respect to a given matter can only have one of power or immunity, never both.

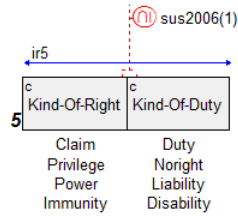
We furthermore offer the opportunity to have fact instances that formally deny the existence of a power (called 'No power legal relation' in Fig. 2) or an immunity as persons find it sometimes useful to be able to express themselves that way.

The following set of terms will be defined, paraphrasing Corbin:

1. Legal relation. A legal relation is a relationship between two parties, one party in a certain kind of right and the other party in a certain kind of duty with respect to a specific matter.
2. Claim. A claim party has the right to ask the question: what must the duty holder do for me with respect to a specific matter?
3. Duty. A duty party has the obligation to ask himself the question: what must I do for the claim holder in this legal relation?
4. Privilege. The privilege holder may ask herself: what may I do, without regard for the noright party?
5. Noright. The noright holder may ask himself: what may the privilege holder do to me in this matter, without any regard for me?
6. Power. The power holder (party A) in a legal relation can ask herself: what new legal relations can I create between party D (the liability holder in the legal relation) and myself of another party?
7. Liability. The liability holder may ask herself: what new legal relations can the power holder create between me and himself and or others?
8. Immunity. The immunity holder may ask herself: which of my existing legal relations is safe from alteration by the disability holder?
9. Disability. The disability holder may ask himself: which of the legal relations of the immunity holder is impossible for me to extinguish?

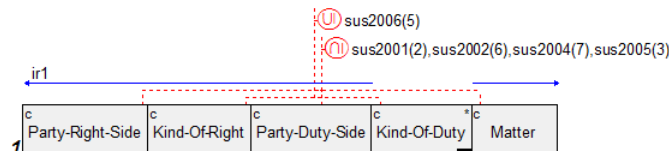
The main parts of the semantic-conceptual model of Hohfeld in a diagrammatic representation:

**Permitted kind of legal relation**



FT5: <Kind-Of-Right> and <Kind-Of-Duty> is a permitted kind of legal relation.  
 1) Claim and Duty is a permitted kind of legal relation.  
 2) Privilege and Noright is a permitted kind of legal relation.  
 3) Power and Liability is a permitted kind of legal relation.  
 4) Immunity and Disability is a permitted kind of legal relation.

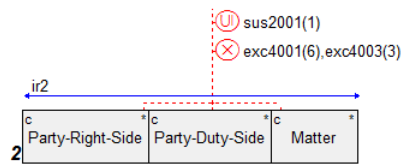
**Legal relation**



FT1: <Party-Right-Side> in the role of <Kind-Of-Right> has a legal relation with <Party-Duty-Side> in the role of <Kind-Of-Duty> with respect to <Matter>.

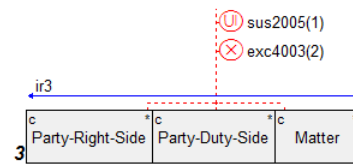
ir1: <Matter>, <Party-Right-Side>, <Kind-Of-Right>, <Party-Duty-Side>

**Power legal relation**



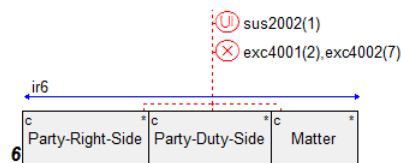
FT2: <Party-Right-Side> in the role of power has a legal relation with <Party-Duty-Side> with respect to <Matter>.

**No power legal relation**



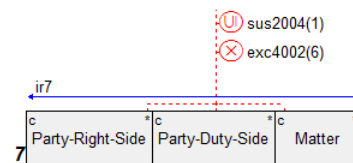
FT3: <Party-Right-Side> has no power legal relation with <Party-Duty-Side> with respect to <Matter>.

**Immunity legal relation**



FT6: <Party-Right-Side> in the role of immunity has a legal relation with <Party-Duty-Side> with respect to <Matter>.

**No immunity legal relation**



FT7: <Party-Right-Side> has no immunity legal relation with <Party-Duty-Side> with respect to <Matter>.

Fig. 2. Diagrammatic representation of the semantic-conceptual model (partial).

**6. Conclusions**

Working in the field of building large scale information systems for organizations that have to base their (IT-) services on rules that they take from sources of law, we

have set ourselves, in co-creation with the members of the Blue Chamber, the goal to develop a systematic, repeatable approach that would allow these organizations improve their efficiency when designing and implementing such systems and keeping them aligned with changes in those sources of law.

We based our work upon the work of Hohfeld, but we have extended his initial categorical model of legal relations with temporal aspects allowing us to connect to events, and framed this extended Hohfeldian model in a formal semantic-conceptual model. Our conceptualization, as we have showed, has the advantage of clarity for it can be used to analyse complex legal rules and provides us with a mechanism that can ‘calculate the meaning’ of situations, by calculating the legal effects thereof. Consequently, we hope our approach is in tradition with what the great philosopher Gottlieb Wilhelm von Leibniz was dreaming of when he suggested ‘calcuemus’, let’s calculate, in his *‘The Art of Discovery’* written in 1685!

In this paper we have presented the formal conceptual model including integrity rules that can be used as a basis for computing legal consequences, given some input situation and allows us to analyze and explain the legal interpretation of complex situations as well as complex rules.

The conceptualization presented here however also has some limitations. In this paper we have focused on an important part of what we have to model: institutional reality. Connecting the institutional reality to brute reality, particularly through qualification of brute facts into legal facts, is only briefly mentioned in this paper, a next paper will be needed to also describe how we see to cover this issue. Similarly, we have not addressed an equally important issue, representing brute reality by maintaining an administrative reality. This topic is specifically interesting for accountancy, business administration etc. When drafting regulations one would have to take this aspect into consideration, for without a proper administrative basis (i.e. brute facts) that can be qualified as legal facts one would have to make lots of effort to make the legal system work.

Despite the work that is still left for us to do, we are convinced that we came closer to our ideal, where drafters of laws and systems designers of services would work together to make life easier for all. By reusing building blocks in sources of law in abstract legal institutional constructions, expressed in legal relations and legal facts and their instantiations for specific regulations, and by standardization of descriptions of reality. Not only would this lead to better and more adaptive information systems in public administration, but also would it help citizens to better execute their rights and fulfill their obligations as well. Last but not least it would enable them to participate in the political debate, being better informed about the political consequences knowing the effects of regulations rather than groping in the dark.

## References

1. Boer, A. (2009). Legal Theory, Sources of Law, & the Semantic Web. *Frontiers in Artificial Intelligence and Applications* 195. IOS Press, Amsterdam, the Netherlands
2. Boer, A. & Van Engers, T.M. (2010). Knowledge acquisition from sources of law in public administration. In P. Cimiano & H.S. Pinto (Eds.), *Knowledge engineering and management by the masses: 17th international conference, EKAW 2010, Lisbon, Portugal, October*

- 11-15, 2010: proceedings Vol. 6317. Lecture Notes in Computer Science (pp. 44-58). Berlin: Springer
3. Boer, A.W.F. & Van Engers, T.M. (2013). Legal Knowledge and Agility in Public Administration. *Intelligent Systems in Accounting, Finance and Management*, 20(2), 67-88
  4. Corbin, A. (1919), *Legal Analysis and Terminology*, Yale Law School
  5. Corbin, A. (1921), *Jural Relations and Their Classification*, Yale Law School
  6. Crosby, A.W. (1997), *The Measure of Reality: Quantification and Western Society, 1250-1600* (Cambridge University Press), 245pp
  7. Van Engers, T.M. (2001), *Knowledge Management, The Role of Mental Models in Business Systems Design*
  8. Van Engers, T.M., Nijssen S. (2014a), *Bridging Social Reality with Rules*, paper presented at IRIS 2014 (Internationales Rechts Informatik Symposium), Salzburg, Austria, to be published in Jusletter-IT
  9. Van Engers, T.M., Nijssen, S. (2014b), *From Legislation towards Service Provision An Approach to Agile Implementation of Legislation*, paper accepted for presentation at EGOVIS 2014 in Munchen, September 1-5 and to be included in the proceedings
  10. Griethuysen, J. J. (Ed.) (1987), *Concepts and Terminology for the Conceptual Schema and the Information Base*. ISO TC97/SC5/WG3, International Standards Organization, Central Secretariat, Geneva, Switzerland (originally published in 1982)
  11. Hohfeld, W.N. (2010), *Fundamental Legal Conceptions as Applied in Judicial Reasoning*, edited by Walter Wheeler Cook, ISBN-13: 978-1-58477-162-3
  12. Nijssen, G.M. (1978), *A Framework for Discussion in ISO/TC97/SC5/WG3*, 78.09/01.
  13. Nijssen, G. (1980), *A Framework for Advanced Mass Storage Applications*. Conference Medinfo ,pp. 1-21, Tokyo
  14. Nijssen, S., & Valera, S. (2012), *An Architecture Ecosystem for the Whole Systems Perspective, Including System Dynamics, Based on Logic & Set Theory and Controlled Natural Languages*, Working paper for the OMG Architecture Ecosystem SIG
  15. Nyquist, C. (2002), *Teaching Wesley Hohfeld's Theory of Legal relations*, *Journal of Legal Education*, Volume 52, Numbers 1 and 2 (March/June 2002)