States of Affairs, Events, and Rules: an Abstract Model of the Law

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Abstract

In this paper, an abstract model of the law is presented that has three primitives: states of affairs, events, and rules. The starting point of the abstract model is that the law is a dynamic system of states of affairs which are connected by means of rules and events. The abstract model can be regarded as an ontology of the law, that can be applied to legal knowledge representation.

After an elaboration of the three primitives, the uses of the abstract model are illustrated by the analysis of central topics of law. Then we discuss heuristic guidelines for legal knowledge representation that are suggested by the abstract model. The paper concludes with a comparison with related work. [1]

1. Modeling the law

In this paper, we present an abstract model of the law that is based on two crucial characteristics of the law. The first characteristic is that the law is a dynamic system of states of affairs. The law evolves over time: regulations change, contracts are signed, property rights are acquired, etc. The second characteristic is that the law is an interconnected system of states of affairs. The elements of the law are not independent of each other, but hang together in a rule-like way: stealing is punishable, the signing of a contract gives rise to obligations.

Our abstract model of the law can be regarded as an ontology. Ontologies have recently attracted considerable interest in the field of knowledge representation in general[2] **and in the field of Law and Artificial Intelligence in particular.**[3] **Motivations for the development of ontologies, or explicit specifications of domain conceptualizations [Gruber 1995], include knowledge sharing and knowledge reuse [Cf. Bench-Capon and Visser 1997]. Our motivation to the development of an ontology is to provide an explicit view of the legal domain with the aim to find heuristic guidelines for legal knowledge representation.**

The abstract model of the law as proposed in this paper can be summarized as follows:

- **The law consists of a system of states of affairs.**

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1) The present paper is an abridged version of a manuscript by Hage and Verheij [1997]. In the manuscript, several other legal topics are analyzed, and a formalization of the abstract model is provided.

2) Cf. the special issues on ontologies of the International Journal of Human-Computer Studies in Vol. 43, 1995 & Vol. 46, 1997 with papers by, e.g., Gruber [1995], Guarino [1995, 1997], Hobbs [1995], Sowa [1995], Van Heijst, Schreiber and Wielinga [1997a and b].

3) Cf. Bench-Capon 1989, McCarty 1989, Valente 1995, Van Kralingen 1995, Visser 1995, and Bench-Capon and Visser 1996, 1997. Cf. also the proceedings of the First International Workshop on Legal Ontologies [eds. Visser and Winkels 1997].

- The law is dynamic: the obtaining states of affairs are subject to change due to the occurrence of events.
- The law is interconnected: there are (directed) connections between the obtaining states of affairs based on rules.

The model uses three primitives:

- States of affairs. A state of affairs can be characterized as a possible part of the world as expressed by a (descriptive) sentence. An example is the state of affairs that the contract has been signed as expressed by the sentence 'The contract has been signed'.
- Events. An event causes a change of the obtaining states of affairs. An example is the event of signing some contract by which the state of affairs that the contract has been signed starts to obtain.[4]
- Rules. A rule is a directed connection between states of affairs. An example is the rule that, if the contract has been signed, obligations of the contractors towards each other emerge.

We start with a description of the abstract model in the sections 2 to 5. In the sections 6 and 7, we illustrate the uses of the model by analyzing the signing of a sales contract and different kinds of rights. (Hage and Verheij [1997] also discuss classification, proof, juristic acts and juristic facts, and validity.) In section 8, we discuss heuristic guidelines for legal knowledge representation as suggested by the abstract model. The model is put in perspective by the discussion of related research in section 9. The paper is summarized in section 10.

2. Two types of connections between states of affairs

Our model distinguishes between two types of connections between states of affairs: causation and constitution. Causation involves the lapse of time, while constitution is timeless. An example about a sales contract illustrates the two types of connections.

Suppose that A sells his car to B by signing a sales contract. The signing of the contract is an event causing that a contractual bond between A and B comes about. The relation between the signing of the contract and the existence of the contractual bond between A and B is one of causation. The contractual bond brings with it that A is obligated to transfer the ownership of his car to B, and that B is obligated to pay A the price of the car. The relation between the existence of the contractual bond and the obligations of A and B towards each other is one of constitution.

In the case of causation, an event changes which states of affairs obtain. Obtaining states of affairs appear or disappear.[5] Graphically, causation is depicted as a horizontal connection between states of affairs (Figure 1).

Figure 1: Causation

In the case of constitution, a state of affairs obtains thanks to another state of affairs that obtains. There is a rule that connects the states of affairs. Graphically, constitution is depicted as a vertical connection between states of affairs (Figure 2).[6]

4) The notions of states of affairs and events as we use them are related to, but not fully identical to those used by Von Wright [1963, p. 25f.].
5) State transitions also played an important role in the model used by Gardner [1987].
6) Visser [1995, p. 92f., p. 155] makes analogous distinctions.

Figure 2: Constitution

In section 5.1, we show that there are not only rules of constitution, but also rules of causation.

In the rest of this paper, we elaborate the abstract model of the law based on the distinction between constitution and causation, and show it to be beneficial for modeling the law.

3. States of affairs

It is convenient to view the law (and the world) as a system of states of affairs. A state of affairs can be characterized as a possible part of the world expressed by a (descriptive) sentence.[7] We take the notion rather broadly. Examples of states of affairs are that:

1. it is raining;
2. George Washington was the first president of the USA;
3. the sun will rise tomorrow;
4. John has taken away Gerald's car;
5. John is a thief;
6. Meryl is under an obligation toward Jane to pay her $100;
7. Meryl ought to pay Jane $100;
8. a minor cannot make a valid will;
9. it is uncertain whether O.J. Simpson killed his wife;
10. from the point of view of civil law, O.J. Simpson killed his wife;
11. from the point of view of criminal law, O.J. did not kill his wife.

Obviously, states of affairs do not necessarily obtain. E.g., the state of affairs that Bill Clinton was the first president of the USA does not obtain. States of affairs that obtain are called facts and are expressed by true sentences. States of affairs that do not obtain are called non-facts and are expressed by false sentences.

As the examples show, states of affairs can be in different tenses (exx. 1-3), can supervene on each other (exx. 4/5, 6/7), can have different modalities (exx. 7-10), and depend on a point of view (exx. 10-11).

3.1. Temporary and durable states of affairs

The examples of states of affairs 1-3 above are in different tenses. We regard the law as a dynamic system of states of affairs: the obtaining states of affairs can change over time. For instance, the state of affairs that Bill Clinton is president of the USA obtains today, but did not obtain in 1967. Some states of affairs can stop or start obtaining, others cannot. For instance, the state of affairs that George Washington was the first president of the USA obtains and will always obtain, since it is a state of affairs about the past.

States of affairs that can stop or start obtaining are said to be temporary, oth-

7) The close relation between states of affairs and sentences implies that the expressive power of the chosen language determines which states of affairs are possible.

erwise durable. An example of a temporary state of affairs is that it is raining; an example of a durable state of affairs is that the French Revolution took place in the 18th century. States of affairs that deal with the past are always durable, because the past does not change. For obvious reasons, tautological states of affairs are also durable. Temporary states of affairs that only obtain for a moment are momentary. A momentary state of affairs is for instance that John hits Gerald.

Temporary states of affairs which deal with the present, such as the state of affairs that it is raining, are called states. In section 7, we show that different kinds of rights can be thought of as states.

3.2. Supervenience

In the examples above, state of affairs 5 depends on state of affairs 4. The state of affairs that John is a thief obtains due to the state of affairs that John has taken away Gerald's car. It is said that the state of affairs that John is a thief supervenes on the state of affairs that he has taken away Gerald's car [Jones 1995].

Supervenience of a state of affairs on another state of affairs is a rather common phenomenon. It can, amongst others, be based on definitions. For instance, something counts as a motor vehicle in the sense of the Dutch Traffic Law (Wegenverkeerswet) if and only if it satisfies a number of conditions.

In general, modal states of affairs, discussed in the next subsection, always supervene on other states of affairs. For instance the state of affairs that Meryl ought to pay Jane $100 (ex. 7 above) supervenes on the state of affairs that Meryl is under an obligation toward Jane to pay her $100 (ex. 6 above).

3.3. Modalities

The examples 7-9 illustrate different modalities. We distinguish three categories of modal states of affairs: anankastic, deontic and probabilistic states of affairs. (Here we do not regard tense as a modality.)

Anankastic states of affairs [Von Wright 1963, p. 10] have to do with the necessary, the possible and the impossible. For instance, the state of affairs that the released stone must fall, is anankastic. Other examples are the states of affairs that hydrogen and oxygen can react, that the Democrats cannot win the elections, and that the conclusion of a deductively valid argument with true premises is necessarily true.

A specific anankastic state of affairs in the law has to do with competence. To perform particular acts in the law, such as engage into a contract, to issue a governmental order, or to legislate, the person who performs the act must have the competence to do so. If the competence is lacking, the particular juristic act cannot exist at all, or is void and has no legal consequences. In other words, competence has to do with what an actor can or cannot do.[8] Juristic acts are discussed more extensively by Hage and Verheij [1997].

Deontic states of affairs have to do with the obligated, the forbidden, and the permitted. Examples are that Meryl ought to pay Jane $100, that smoking is prohibited in public buildings, and that John is allowed to take a day off.

Two basic categories of deontic states of affairs are usually distinguished: deontic states of affairs of the ought-to-do type and of the ought-to-be type. Examples of the first category are that car drivers ought to drive on the right hand side of the road, that public officers are prohibited to accept bribes, and that John is permitted to walk in the park. Examples of the second category are that car drivers ought to be

8) In the law, competence is sometimes assumed to be a state of affairs of the deontic modality. On that assumption, competence is considered to imply primarily the permission to perform an act in the law. However, it is better to consider the capability to perform the act as the primary modal state of affairs implied by competence.

sober, that it is forbidden that high public officers are members of parliament, and that it is permitted that Jane walks in the park.

Deontic states of affairs should be distinguished from the non-modal states of affairs on which they supervene. An example is the state of affairs that there is a contractual bond between two parties, which underlies the state of affairs that one party has to pay the other.

Probabilistic states of affairs have to do with the probable, the certain and the uncertain. Examples of probabilistic states of affairs are that it will probably rain, that the train definitely will be late, and that Jane might pay her bill.

Probabilistic states of affairs should be distinguished form anankastic states of affairs: the reasons why something is necessary are not those which make something probable or certain. The announcement that the train will be late makes it highly probable that the train will be late, but does not make it necessary.

1.3.4. Points of view

The examples of states of affairs 10-11 depend on a point of view. Points of view include the logical, the physical, the biological, the social, and the legal point of view. As the examples show, the legal point of view encompasses the points of view of civil and criminal law.

It should be noted that states of affairs can belong to more than one point of view. For instance, the state of affairs that John should be punished can belong to the social, the moral, and the legal point of view. Moreover, states of affairs from different points of view can conflict. For instance, the states of affairs that O.J. Simpson killed his wife and that he did not kill his wife belong to the point of view of civil and of criminal law, respectively. Because these facts belong to different points of view, the conflict does not lead to an inconsistency.

4. Events

Events cause changes in the total set of obtaining states of affairs. For instance, if it starts to rain, the state of affairs that it is raining starts to obtain. Other examples of events are

1. the starting of the European Economic and Monetary Union;
2. the apple's falling to the ground;
3. Jane's dying;
4. John taking away the car of Gerald;
5. the Supreme Court annulling the judgement of the Court of Justice;
6. an international treaty being ratified;
7. the transfer of the ownership of a house.

Notice that the occurrence of an event is itself a (momentary) state of affairs, for instance the state of affairs that John takes away Gerald's car.

A special kind of events are acts: events that consist of the intentional behavior of an individual (exx. 4-7). A special category of acts are the so-called juristic acts (exx. 5-7). Juristic acts are discussed more extensively by Hage and Verheij [1997].

4.1. The effects of an event

By an event, one or more states of affairs State of affairs1 stop obtaining and other states of affairs State of affairs2 start to obtain (Figure 3). For instance, if the event that it starts to rain occurs, the state of affairs that it is not raining stops obtaining, and the state of affairs that it is raining starts to obtain.[9]

Figure 3: By an event, states of affairs stop and start to obtain

We will use rectangular boxes to denote states of affairs, and rounded boxes to represent events. Arrows indicate the directed connection between states of affairs. If the state of affairs that stops to obtain by an event is trivial or irrelevant, it is not shown (Cf. Figure 4).

Figure 4: The initial state of affairs is sometimes not shown

Since the occurrence of an event is itself a state of affairs, there is another way to depict the event of Figure 3:

Figure 5: The occurrence of an event as a state of affairs

To indicate that the occurrence of an event is a special state of affairs related to an event, it is shown as a rectangular box containing a rounded box.

An event can have effects on more than one level. For instance, the event of signing a sales contract trivially results in the state of affairs that the sales contract has been signed. The same event also has the (derived) effect that the signing parties engaged into a contractual bond. Moreover, the contractual bond between the parties involves that the one party has an obligation toward the other party, which in turn involves that the party under the obligation has a duty to perform some action. The relations are depicted in Figure 6. The vertical arrows are examples of constitution.

4.2. Supervenience of events

Events can supervene on other events, just as states of affairs can supervene on other states of affairs. This is illustrated by the example of the signing of a contract that indirectly leads to the existence of a contractual bond (Cf. Figure 6). The event of signing of the sales contract implies the event of engaging into a contractual bond. We say that engaging into a contractual bond supervenes on the signing of the contract.

Each of the derived effects of the signing of the sales contract in Figure 6 can be regarded as the result of an event that supervenes on the signing of the contract, as shown in Figure 7.

9) Note that each state of affairs has a 'negation'. Therefore, the event that it starts raining marks that the state of affairs that it is raining begins, but ipso facto also that the state of affairs that it does not rain ends.

Figure 6: An event can have derived effects

In Figure 7, arrows seem to be used in a new way, namely between supervening events. However, if the alternative way of depicting events (as in Figure 5) is used, it turns out that the supervenience of events can be regarded as a special case of the supervenience of states of affairs. Cf. Figure 8.

5. Rules

A directed connection between states of affairs is called a rule. It is, for instance, a rule that if a contract is signed, a contractual bond between the contracting parties has come into existence. The formulation of a rule should be distinguished from the state of affairs that this rule exists. It is possible to formulate all kinds of rules, but obviously not all of these possible rules exist. The existence of a rule is a particular state of affairs, which may obtain or not. Connections between states of affairs can only be based on rules which actually exist.

The reader should be aware of other philosophical and legal connotations of the term 'rule' that might be confusing. Rules in our sense include many divergent phenomena, such as physical laws, rules of evidence, power conferring rules, and legal norms. For instance, Newton's law of gravitation is in our terminology a rule, because it connects the states of affairs that two bodies have masses m_1 and m_2, and the state of affairs that these bodies attract each other with a force equal to Gm_1m_2/r_2 (where G is the gravitational constant and r is the distance between the gravitational centers of the bodies).

It might be a rule of evidence that if three independent witnesses saw someone commit the crime, this person counts as having committed the crime. This hypothetical rule connects the states of affairs that Peter, Paul and Mary saw Snoopy kill Ice T and that Snoopy counts as having killed Ice T.

It is a power conferring rule that if the legislator attributes some legal body with the competence to perform a particular juristic act, this body can perform that act. This rule connects for instance the states of affairs that the legislator gave the

Figure 7: An event can supervene on another event

Figure 8: Two ways of depicting the supervenience of events

community council the power to make by-laws, and that the community council can make by-laws.

A rule consists of a condition part and a conclusion part. The condition part consists of one or more generic states of affairs (as expressed by a sentence with variables), while the conclusion consists of one single generic state of affairs. In applying the rule, the generic states of affairs are instantiated. For instance, it might be a rule that thieves ought to be punished. The condition part of the rule is the generic state of affairs that someone is a thief; the conclusion part is the generic state of affairs that someone ought to be punished. If the rule is applied to the case of the thief John the condition part of the rule is instantiated to the state of affairs that John is a thief. The conclusion part is correspondingly instantiated to the state of affairs that John ought to be punished.

5.1. Rules of constitution and rules of causation

In section 2, we discussed two fundamental types of connections between states of affairs, that is constitution and causation. This distinction corresponds to a similar distinction between types of rules.

If one state of affairs constitutes another one, there is a constitutive rule under-

lying the connection.[10] An example is the rule that someone is checkmated if the King is threatened and the threat cannot be taken away in one move. The state of affairs that the King is threatened and the threat cannot be taken away in one move is the reason that someone is checkmated.

A state of affairs can be brought about by an event. Rules which govern the relation between an event and the effects that result from it are called causal rules. An example is the rule that heating an object (an event) makes that the heated object is warmer than before. The event does not have to be a purely physical event. For instance, signing a sales contract is the (legal) cause for the existence of a contractual bond.

Since the condition part of rules can only contain states of affairs, there is no place for events in the rule conditions. Therefore causal rules must attach consequences to the occurrence of an event, which is a state of affairs, possibly in combination with other states of affairs. For instance, there might be a causal rule that if somebody has the competence to make laws (a state of affairs) and exercises this competence (the occurrence of an event), the law that was made is valid (state of affairs of the conclusion). This construction is depicted as follows:

Figure 9: The occurrence of an event as a state of affairs

The causal rule connecting the states of affairs that L is competent and that L makes law XYZ to the state of affairs that law XYZ is valid is represented as a circle (Cf. Figure 2, Figure 5).

5.2. Defeasibility

Although rules are formulated in the 'If ..., then ...'-form, they do not guarantee their conclusion if their conditions are satisfied. A rule that guarantees that its conclusion obtains if its conditions obtain is called strong, otherwise weak. The application of weak rules is defeasible. The usefulness of the notion of a rule is considerably enhanced by this possibility of defeasible rule application.

Two main types of defeasibility of rule application have been distinguished. First, the connection between the conditions and conclusion of a rule may be blocked for some reason. For instance, the connection between condition and conclusion of the rule 'If the weather is good on Sunday, the highways are full' is blocked if there is a driving restriction because of an ozone alert. A legal example would be that application of the rule that thieves ought to be punished is blocked if the thief is a minor. Such reasons blocking the application of a rule are called undercutters

10) Notice that our use of the term 'constitutive rule', which is opposed to a causal rule, deviates from Searle's [1969] use which distinguishes between constitutive and regulative rules.

[Pollock 1987], exclusionary reasons [Raz 1975; Hage 1997], or just exceptions to a rule.

Second, rules can have incompatible conclusions, so that they cannot all lead to their conclusions. For instance, if the conditions of the rule 'If the weather is good on Sunday, the highways are full' and 'If there is an international soccer match, the highways are empty' obtain, the state of affairs that the highways are full can be undetermined. In the law, this type of defeasibility is related to priorities between legal rules (as for instance in cases of Lex Superior) and the weighing of opposing reasons resulting from legal principles.

Hage and Verheij [1997] discuss an example of an exception to a rule from the point of view of our abstract model. Hage [1996, 1997] and Verheij [1996] (among others) discuss the topic of defeasibility more extensively.

Hage and Verheij [1997] take the relation between rules, principles and goals into account (Cf. also Verheij, Hage and Van den Herik [forthcoming]).

6. Signing a sales contract

In the sections 6 and 7, we illustrate the uses of the abstract model of the law by analyzing some central legal topics.

As our first example of the application of our abstract model, we elaborate the example of signing a sales contract, that was used throughout the discussions above. The following figure extends Figure 7.

Figure 10: Signing a sales contract

We have eight states of affairs, four events, and three rules. Four of the states of affairs form the initial state, when:

- the sales contract is not signed by A and B,
- A and B are not under a contractual bond,
- A is not under an obligation towards B, and
- A ought not to perform some action.

In this initial state, four events take place:

- A and B's signing of the sales contract,
- A and B's engaging into a contractual bond,
- A's undertaking of the obligation towards B to pay him the sales price,
- the emerging of A's duty to pay B the sales price.

The events lead to the four states of affairs that form the final state:

- the sales contract is signed by A and B,
- A and B are under a contractual bond,
- A is under an obligation towards B, and
- A ought to perform some action.

The states of affairs in the final state supervene on each other: the state of affairs that A ought to perform some action supervenes on the state of affairs that A is under an obligation towards B, which in its turn supervenes on the state of affairs that A and B are under a contractual bond, which supervenes on the state of affairs that the sales contract is signed by A and B.

The connections between these states of affairs result from three rules:

1. A signed sales contract leads to a contractual bond.
2. A contractual bond implies obligations of the contracting parties towards each other.
3. An obligation implies the duty to perform the contents of the obligation.

The events also supervene upon each other, just as the final states of affairs. The emerging of A's duty to pay B the sales price supervenes on A undertaking the obligation towards B to pay him the sales price. A's undertaking of this obligation supervenes on A and B's engaging into a contractual bond, which on its turn supervenes on the signing of the sales contract.

The connections between these events result from three rules, closely related to the three rules above:

1'. Signing a sales contract is a form of engaging into a contractual bond.

2'. Engaging into a contractual bond implies the undertaking of obligations of the contracting parties towards each other.

3'. Undertaking an obligation implies the emerging of the duty to perform the contents of the obligation.

In the figure, three more rules are marked, that non-trivially connect the events and the final states of affairs:

1". Signing a sales contract leads to a contractual bond.

2". Engaging into a contractual bond implies obligations of the contracting parties towards each other.

3". Undertaking an obligation implies the duty to perform the contents of the obligation.

There are also the trivial connections between the events and the states of affairs that start to obtain by them, e.g., the event of signing the contract that leads to the state of affairs that the contract is signed. Notice that the non-trivial effect an event (as results from the rules 1", 2" and 3") is the trivial effect of its supervening event.

The rules in a triplet such as 1/1'/1" are closely related, and are in practice not distinguished.

7. Rights

We discuss three kinds of rights in our abstract model: claims against some concrete person (iura in personam), property rights (iura in re), and human rights. It turns out that the three kinds of rights are states, i.e., momentary states of affairs (Cf. section 3.1).

7.1. Claims

In his paper Tû-tû, Ross [1957] writes the following: [11]

> "We find the following phrases, for example, in legal language as used in statutes and the administration of justice:
>
> 1. If a loan is granted, there comes into being a claim;
> 2. If a claim exists, then payment shall be made on the day it falls due;
>
> which is only a roundabout way of saying:
>
> 3. If a loan is granted, then payment shall be made on the day it falls due.
>
> That 'claim' mentioned in (1) and(2), but not in (3), is obviously [... omission added, JH & BV] not a real thing; is nothing at all, merely a word, an empty word devoid of all semantic reference."

Here Ross provides an account of phenomena like claims as mere intermediaries between facts: the intermediary is only a manner of speaking, and does not really exist. While rejecting this reductionist consequence, MacCormick and Weinberger [1986] adopt the idea that certain legal states of affairs function as an intermediary between other (legal) states of affairs. They describe a particular category of legal concepts, called institutional legal facts, in our terminology related to states of affairs supervening on other states of affairs [MacCormick and Weinberger 1986, p. 52/3]. Institutional legal facts have certain features in common:

For each of them, the law contains rules that lay down when, e.g., a contract, a corporation, or an obligation of reparation, comes into existence. These rules are called institutive rules. The law also contains rules that attach further legal consequences in case these concepts apply (if the concerning institutional legal facts obtain). These rules are called consequential rules. And, finally, the law has rules that determine when the phenomena at stake disappear again. These rules are called terminative rules. Cf. Figure 11.

The figure agrees with our abstract model. Institutional legal facts are then states the coming into existence and disappearing of which is regulated by causal rules. Constitutive rules deal with the states of affairs which are constituted by states. As Ross' discussion shows, claims fit nicely in this picture.

Figure 11: Institutional legal facts

7.2. Property rights

The next example is having a property right, such as the ownership of a house. We discuss the legal consequences of the ownership of a house, and ways of acquiring and losing ownership.

If A owns the house H, it holds that, with the exclusion of everybody else, A is entitled to use, say inhabit, the house. Moreover, A has the power to transfer the ownership. The law may also attach other legal consequences to the ownership of a house. In the Netherlands and in Belgium, owners of houses are, for instance, subject to special taxes. These consequences of ownership are attached by special

11) Quotation after Lloyd [1979, p. 625].

legal rules to the state of ownership. The rules might have been different, which goes to show that the legal consequences of ownership are not part of the ownership itself, but rather states of affairs which are non-causally connected to ownership.[12]

The ownership of a house can be acquired in different ways. The most common one is that somebody else was the owner, and transferred his ownership to the new owner. Such a transfer is an event which has the direct effects that the original owner loses his property right, and that the new owner acquires it. The transfer has also indirect effects, because all legal consequences which are attached to ownership disappear for the original owner and come into existence for the new owner.

Another way to acquire the ownership of a house is to build the house on ground which one owns. This event only causes a new ownership to come into existence, not the disappearance of a previous ownership. The passing away of the original owner is a way for an inheritor to acquire ownership. All these different ways of becoming the owner of a house indirectly lead to the legal consequences attached to ownership.

There are also several ways to lose ownership. Transfer is again the most prominent one, but passing away of the owner, devastation of the property, prescription, and expropriation are other ways to lose ownership.

As this example about the ownership of a house illustrates, property rights can be treated as 'empty' states, the coming into existence, the (legal) consequences, and the disappearance of which is governed by rules. Cf. Figure 12.

Figure 12: Acquisition, consequences, and loss of ownership

The similarity of Figure 11 and Figure 12 is obvious.

7.3. Human rights

Human rights, such as the right of freedom of expression, differ in nature from property rights. Nevertheless, having a human right is also a kind of state, and is in that respect very similar to having a property right. We take a closer look at the freedom of expression.

If P has the freedom of expression, this has several consequences. The first and foremost consequence is that P is in principle permitted to express his opinion about any issue. (Remember the defeasibility of rule application.) If we follow Dworkin [1978, pp. 184f.], having a human right also involves that regulations that infringe these rights are invalid. In other words, for regulations that infringe these rights, the rule that regulations which were validly made contain valid law is not applicable [Cf. Hage 1997, p. 173].

Legal systems usually attribute human rights to all persons on the basis of their being humans. This means that (instances of) human rights come into existence

12) It may be argued that some consequences of ownership are so essential that if they would not exist, the underlying state would not be ownership anymore, but rather some other state. The discussion of this view falls outside the scope of this paper.

as soon as a human being comes into existence, and end when human beings pass away.

The important thing to the note about rights is that, in spite of the different nature of claims, property rights and human rights, the same scheme applies: there are events by which these rights come into existence, and other events by which they disappear again; rules of law determine the legal consequences of the rights. In other words, rights are legal states on which legal consequences supervene (in the sense of the sections 3.1 and 3.2).

8. Heuristic guidelines for legal knowledge representation

As an application of the abstract model of the law, we discuss heuristic guidelines for legal knowledge representation as suggested by the model.

A representation of a legal domain based on our abstract model needs the three primitive elements, that is states of affairs, events, and rules. In principle, events and rules can even be represented by corresponding states of affairs of the occurrence of events and the validity of a rule. However, it is wise to distinguish the three primitives, because of the different functions of the three primitives in the abstract model.

The following heuristics for the representation of a legal domain are suggested by our abstract model: [13]

1. Identify (preliminarily) the types of states of affairs, events, and rules occurring in the domain. These form the skeleton of the representation.
2. Determine for each state of affairs whether it supervenes on another state of affairs. Check for every supervening state of affairs whether the rule which connects it with its underlying states of affairs was already identified. Avoid circular connections of states of affairs, where one state of affairs in the end supervenes upon itself. All modal states of affairs and states of affairs which deal with exceptions to rules, validity, or proof, must supervene on other states of affairs.
3. Identify which states of affairs are states. Determine for every state which events govern its coming about and disappearing. Check whether these events were already identified as belonging to the domain.
4. Check for every event whether the rules which govern its effects have already been identified.
5. Check for all rules whether their application is defeasible or not. Check for all defeasible rules which states of affairs in the domain may block their application. Check for every potential exception whether the rule which governs its effects was identified.

These heuristic guidelines for legal knowledge representation end the exposition of our abstract model of the law. In the following section we will briefly compare our model with related work.

9. Related research

We put our abstract model of the law in perspective by a discussion of related work by Valente [1995], and Van Kralingen [1995] and Visser [1995]. Hage and Verheij [1997] also discuss the work of McCarty [1989] and the relations of the present abstract model with Reason-Based Logic [e.g., Hage and Verheij 1994; Hage 1996, 1997; Verheij 1996].

13) Hage and Verheij [1997] give two additional heuristic guidelines, based on the distinction of rules, principles and goals and on the role of proof in the law.

9.1. Valente's functional ontology of law

Valente [1995] has developed a functional ontology of law. This ontology is based on a functional perspective on the legal system, in which it is assumed that the main function of the legal system is to react to social behavior [Valente 1995, p. 49].

Valente extends this functional perspective from the legal system as a whole to the elements of the legal system, which he discusses as categories of legal knowledge. He distinguishes six primitive categories of legal knowledge, that is normative knowledge, world knowledge, including classificatory and causal knowledge, responsibility knowledge, reactive knowledge, meta-legal knowledge, and creative knowledge.

In our abstract model, Valente's primitive categories of legal knowledge (except creative knowledge) correspond to different kinds of legal rules, where the differences between the kinds of rules is based on different kinds of conclusions of the rules. For instance, normative knowledge would consist of rules with deontic conclusions, while responsibility knowledge would consist of rules in which behavior is imputed to actors. To the extent that the knowledge categories of Valente correspond to kinds of rules in our terminology, Valente's distinctions can be regarded as a refinement of our abstract model.

Valente's category of creative knowledge cannot be regarded as a kind of rules. The legislator uses, according to Valente, creative knowledge, if he creates some entity that did not exist before in the world. An example would be the creation of a department within the government or a company [Valente 1995, p. 67]. What Valente calls the use of creative knowledge corresponds in our view more or less to the performance of a juristic act.

9.2. The frame-based conceptual model of Van Kralingen and Visser

In two dissertations defended on the same day, Van Kralingen [1995] and Visser [1995] have developed a frame-based conceptual model of the law. They distinguish three main types of entities, which can be represented in three corresponding types of frames. The entity types are norms, acts, and concepts [Van Kralingen 1995, chapter 3].

Two types of norms are distinguished, namely norms of conduct and norms of competence. These two types both belong to the category of rules in our terminology. Moreover, they identify eight slots in norm frames, four of which stand for elements of the content of the norm, such as its legal modality and the conditions of application, and four of which stand for other characteristics of the norm.

Acts are discussed primarily from the point of view of legislation which deals with acts. The authors identify six characteristics of acts, but the corresponding frames for acts have fourteen slots, three of which deal with auxiliary information about the norm in which the act is mentioned.

Just as acts, concepts are primarily dealt with as elements in rules about the concepts, e.g., in legal definitions. Concept frames have seven slots.

Because of their focus on the elements of norms and rules of meaning, the work of Van Kralingen and Visser can be seen as a refinement of and an addition to the minimal theory about the internal structure of states of affairs, events and rules as presented in this paper (and explicit discussed by Hage and Verheij [1997]). (Notice that the structure of a norm can be seen as part of the structure of the states of affairs that a norm is valid.)

10. Summary and conclusion

We have presented an abstract model of the law. The primitives of the model are states of affairs, events, and rules. The model of the law can be summarized as the view of the law as a dynamic system of states of affairs, which are connected by events and rules.

To illustrate the uses of our model, we have given examples of legal topics that can fruitfully be analyzed in terms of the model. Moreover, we used the model to suggest heuristic guidelines for legal knowledge representation.

The high level of abstraction of the abstract model makes it possible to make many additions to this model in which details of it are refined. In the discussion about related research, we have indicated how the work of Valente, Van Kralingen and Visser provides such refining additions. Our abstract model can be thought of as a 'top ontology' of the law.

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