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**ABSTRACT:**
In this paper we shall focus on an important class of constitutive norms, which we shall call *source-norms*, namely those norms establishing what norms, on basis of what properties, validly belong to a normative system. Institutions including their own source-norms – here called *Self-Regulated Institutions* – are able to incorporate dynamically and autonomously new (old) norms in their normative system. After describing these concepts, we shall present a formal model of source-norms built by exploiting the PRATOR system for defeasible argumentation and we shall try to apply it to electronic institutions.

**KEYWORDS:**
law

# Contents

# Source Norms and Self-Regulated Institutions*

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## 1 Source-Norms

Source-norms establish what other norms, on basis of what properties, validly belong (or do not belong) to a normative system. This category of norms has a large scope, as we shall see, including norms empowering legislators to issue new statutes, norms enabling parties to regulate their relations through contracts, norms authorising judges to decide cases, and also norms determining the legal validity of customs, soft laws, doctrinal options, and so on. The general idea of a source-norm is related to, but not identical with, other concepts with have been used in jurisprudence.

For instance, Hans Kelsen (1934) introduces two ideas, namely, the idea of a *fundamental norm* (*Grundnorm*) and the idea of an *authorising* or empowering (*ermächtigend*, in German) norm. By a fundamental norm he means a single norm which has not been stated by an authority and which is sufficient, together with all relevant facts, to identify all legally valid norms. By an authorising norm, he means every other norm which gives an authority the power to create further norms. As he sees it, the fundamental norm is usually limited to stating that the constitution of a legal system is legally valid, where a constitution, intended in a material sense, comprises the rules governing the production of general norms (or rather the topmost of such rules). From the validity of a constitution (recognizing, for instance, legislation and custom as valid legal sources) we can infer the validity of rules issued by the legislator or customarily practiced. Similarly, from the validity of legislative rules we can infer the validity of regulations issued by administrative authorities, in case the legislation confers upon such authorities the power to issue valid norms.

Our notion of a source-norm is broader than Kelsen's idea of a fundamental norm, since it includes not only the (fundamental) norm which confers legal validity on Constitution, but also constitutional norms conferring legal validity upon legislative norms, legislative norms conferring legal validity upon administrative regulations or upon contractual clauses, administrative regulations or contractual clauses conferring validity upon rules state by other authorities or private organs, and so on. Our concept of a source-norm covers indeed all norms that enable (empower) the production of further norms, by different actors, performing different kinds of acts: legislative bodies approving statutes, administrative authorities adopting general regulations or individual measures, judges issuing decisions, private parties making contracts, or citizens practising a shared custom. Note that source norms cover different kinds of norm-producing events: not only cases when certain agents intentionally state normative proposition in order to make it binding (as for legislators and judges) but also cases when a social behaviour generates a binding norm though the concerned individual did not behave that way in order to generate the

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corresponding norm (as in customary norms), or at least did not behave with the intention of generating the norm as a normative result of one's behaviour (as for doctrinal opinions).

Similarly, our concept of a source-norm can be related to Hart's (1997) concept of *secondary rule*, by which he means a norm regulating the creation, modification or application of other norms, as distinct from the primary rules establishing what actions that individuals should do or not. In fact, our source-norms include rules belonging to all the three categories in which Hart classifies his secondary rules: the *rules of recognition* specifying what features a rule should exhibit in order to be considered a source of the law; the *rules of change* empowering legislator to produce and change existing norms according to certain procedures, the *rules of adjudication* empowering certain individuals or bodies to settle disagreements about the primary rules or to punish the violation of primary norms. Our concept of source-norms, however, does not cover those rules addressed to legislator or judges, but which concern duties whose violation does not entail the invalidity of the concerned norms (for instance a legislator's duty to attend a certain number of session, or the judge's duty not to receive gifts from the parties). Thus, not all norms regulating a procedure for the production of legal norms qualify as source-norms, but only those which indicate (sufficient or necessary) conditions for such a procedure to be able to deliver legal norms.

## 2 A Taxonomy of Source-Norms

We can classify source-norms into different classes. With regard to the kind of event which is enabled to produce new norms, we can distinguish the following classes:

- *enactment-recognizing source-norms*, which empower the enactment of new norms through declarations aimed at creating such norms (as it happens in legislation, administrative regulations, contracts, and judicial decisions with regard to the parties of the case), and
- *practice-recognizing norms*, which give legal validity to the rules governing certain practices (on the basis of this very fact, as it is the case for customs and precedent).

Enactment-recognizing source-norms can be further distinguished into the following classes:

- *authority-based source-norms*, which enable the creation of norms unilaterally imposed on their addressees (as for statutes and regulations), and
- *agreement-based source-norms*, which provide for the creation of norms through the agreement of their addresses (as for contracts).

Note that, following Hans Kelsen (1967), we assume that also statements regulating the behaviour of specific individuals (such as contracts or judicial decisions) qualify as norms, so that also the rules establishing the legal validity of such statements qualify as source-norms.

Practice-recognizing source-norms can be further distinguished into the following classes:

- *precedent-based source-norms*, which enable the creation of norms through precedents and
- *customary-based source-norms*, which provide for the creation of norms through customs.

With regard to the origin of the source-norm, we can distinguish the following classes:

- *fundamental* or *recognition source-norms* (the top level source-norms of an institution), whose validity does not depend on other source-norms of the institution, and

- *dependent source-norms*, which are qualified as valid by other source-norms of the institution (and in particular, by specifically enacted source-norms).

For instance, a law authorising a public agency to issue certain norms (for instance, the norm authorising the privacy authority to issue regulations concerning the security of personal data in the public administration) would be an enactment-recognizing source-norm and a dependent one (being valid on the basis of the higher level source-norm giving legislative power to the legislator). Note that the two qualifications (fundamental and dependent) are not really exclusive, since a source-norm having an independent validity can be reiterated as a rule which is valid on the basis of another source-norm: for instance the rule according to which private parties can make legally binding contracts can be stated by a legislator (and thus be valid on the basis of the fact that legislative statements produce valid rules), but such a rule would certainly be recognised as valid also in the absence of a legislative statement to this effect. In Fig. 1 you can see a graphical representation of the distinctions just introduced.

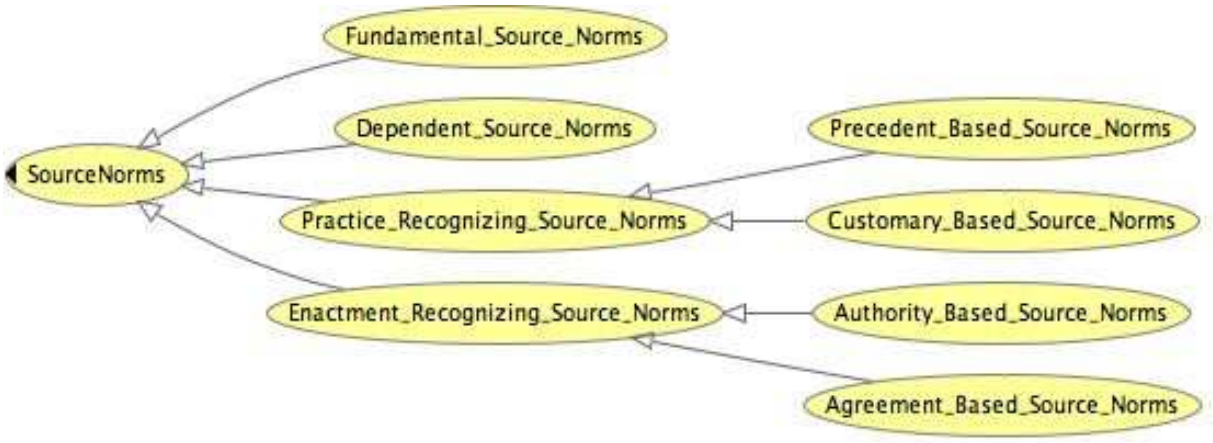


Figure 1: A taxonomy of source norms

By taking into account the fact that a norm's validity depends on the validity of the norm that has enabled its creation (by conferring this effect) upon a certain kind of event (fact or act), we can establish a "genetic" hierarchy of norms. Such a hierarchy can be useful in case of conflict between norms, though such genetic relation of superiority (where the superior kind of law is the one providing for the validity of the lower one, like when a legislative rule confers validity to administrative regulations) should not be immediately assimilated to the relation of superiority which is used to decide conflicts of laws issued by different sources (where the superior kind of law is that which cannot be derogated by the lower one, while being able to derogate it).

## 2.1 A Formal Model of Source-Norms

To formally express source-norms (in a computable language) we refer to the PRATOR system for defeasible argumentation proposed in Prakken and Sartor (1997). In such a system, the rules are expressions of the form

$$r : L_0 \wedge \cdots \wedge L_j \wedge \sim L_k \wedge \cdots \wedge \sim L_m \Rightarrow L_n$$

where $r$, a first-order term, is the name of the rule and each $L_i$ $(0 \leqslant i \leqslant n)$ is a strong literal. The conjunction at the left of the arrow is the antecedent and the literal at the right of the arrow is the consequent of the rule.

Rules can be divided into two categories:

- defeasible rules, which express information that is intended by the user of the system to be subject to debate;

- strict rules, which represent the information that is intended to be beyond debate.

For example the norm "If $X$ sells object $O$ to $Y$ then $O$'s ownership immediately passes from $X$ to $Y$" can be expressed as the defeasible rule:

$$r1 : sells(X, O, Y) \rightarrow ownership(O, Y)$$

This norm is correctly represented through a defeasible rule since only normally the purchase of an object determines the transferal of its property (there are cases where such transfer can be delayed or conditioned to future event).

An example of strict rule is "if X is a sale then X is a contract":

$$s1 : sale(X) \rightarrow contract(X)$$

By using PRATOR's rule language, each source-norm can be modelled as a defeasible rule, having as a consequent $legal(X)$, namely, the legality (the legal validity) of the norms produced by the kind of source-event described in the antecedent of the source-norm, a source event embedding the norm it creates (whose legality it produces). The kind of embedment at issue will depend upon the kind of source at issue. For instance, a legislative act (the act of approving a legislative text) embeds the norms it states, a judicial decision embeds its *rationes decidendi*, a custom embeds the norms of whose practice it consists, etc. In general a source-norm will have the form:

$$label : happens(X) \wedge sourceEvent(X) \wedge embeds(X, Z) \rightarrow legal(Z)$$

where the form of embedment will depend on the kind of norm at issue. For instance a rule conferring legal validity to stated legislation can be expressed in a simplified way (omitting in particular temporal references) as

$$label : happens(X) \wedge legislativeAct(X) \wedge states(X, Z) \rightarrow legal(Z)$$

A rule conferring legal validity to *rationes decidendi* of precedents will be represented as:

$$label : happens(X) \wedge judicialDecision(X) \wedge basedUponRatio(X, Z) \rightarrow legal(Z)$$

Only legal (legally valid) norms can be used in legal inferences. These will be the fundamental norms whose legality (legal validity) is assumed, or the dependent norms whose legality depends on higher-level source-norms. Thus we are led to a chain of legality inferences where the legality of primary norms $n_1$ depends on the legality of source-norm $n_2$ (conferring legal validity to $n_1$, on the basis of its generating event), whose legality depends on the validity source-norm $n_3$ (conferring validity to $n_2$, on the basis of its generating event), and so on.

We can devise different ways to implement this procedure in an automatic reasoner. Consider the following knowledge base:

$f1 : inPublicSpace(john)$
$f2a : happens(smokeActEnactment)$
$f2b : legislativeAct(smokeActEnactment)$
$f2c : states(smokeActEnactment, n1b)$
$f3a : happens(costitutionEnactment)$
$f3b : constitutionalAct(costitutionEnactment)$
$f3c : states(costitutionEnactment, n1a)$
$a1 : fundamental(n3)$
$n1a : inPublicSpace(X) \rightarrow forbidden(X, speakAgainstGovernement)$
$n1b : inPublicSpace(X) \rightarrow forbidden(X, smoke)$
$n2 : happens(X) \wedge legislativeAct(X) \wedge states(X, Y) \rightarrow legal(Y)$
$n3 : happens(X) \wedge constitutionalAct(X) \wedge states(X, Y) \rightarrow legal(Y)$
$a2 : fundamental(X) \rightarrow legal(X)$
$q1a : norm(n1a)$
$q1b : norm(n1b)$
$q2 : norm(n2)$
$q3 : norm(n3)$

This knowledge base contains all the information for deriving the substantive conclusion that John is forbidden to smoke according to the law (to legally valid norms). This follows from norm $n1b$ combined with fact $f1$, $n1b$ being legal according to norm $n2$ combined with facts $f2a$, $f2b$ and $f2c$, $n2$ being legal according to norm $n3$ combined with facts $f3a$, $f3b$ and $f3c$, $n3$ being legal according to assumptions $a1$ and $a2$.

The most direct way to use this information to derive appropriate legal conclusions consists in assuming that every legally valid inference embeds all steps required for establishing the legal validity of the norms used, from the lowest norm at issue up to the fundamental rule at the top of its validation chain. However, this overburdens substantive legal arguments with all inferences needed to establish the legal validity of the norms they use. This is not normally done in common legal reasoning, where inferences about substantive legal conclusions are usually distinguished from inferences about legal validity, though the failure to establish the legal validity of a norm undermines the legal acceptability of inferences using such norms. Moreover this approach would require us to modify the inference model of PRATOR, adding to it a check of legal validity (as in Yoshino 1995 and Hernandez Marín and Sartor 1999).

To achieve all this results (separating substantive inference from legal-validity inferences, making substantive inferences dependent on the legal validity of their normative premises, leaving unchanged PRATOR's inference model) we add in the knowledge base a meta-norm stating that a norm is inapplicable if it is not provable that it is legal, that is

$$nl : norm(N) \wedge \sim legal(N) \rightarrow \neg applicable(N)$$

Consequently, failure to establish the legal validity of a norm providing a legal conclusion will determine the inapplicability of that norm, and thus will strictly defeat the argument including such norm (since such an argument uses an inapplicable rule). Assume that we develop the following argument $A_1$ for the conclusion $forbidden(john, speakAgainstGovernement)$ (for the reader's ease, we include general rules in the arguments rather then the corresponding ground instance, when this helps readability):

$$\begin{aligned} A_1 = \quad & f1 : inPublicSpace(john) \\ & n1a : inPublicSpace(X) \rightarrow forbidden(X, speakAgainstGovernement) \end{aligned}$$

The argument supports the conclusion $forbidden(john, speakAgainstGovernement)$ by stating that John is in a public space, and that if one is in a public space one is forbidden to speak against the Government. However, this conclusion cannot be justified (on the basis of the above knowledge base), since $A_1$ is strictly defeated (and overruled) by counterargument $A_2$ (saying that rule $n1a$ is inapplicable, being a norm which is not legal), which holds undefeated with regard to the knowledge base above (having no counterargument):

$$\begin{aligned} A_2 = \quad & q1a : norm(n1a) \\ & nl : norm(n1a) \wedge \sim legal(n1a) \rightarrow \neg applicable(n1a) \end{aligned}$$

Consider, on the other hand, the following argument for $forbidden(john, smoke)$:

$$\begin{aligned} A_3 = \quad & f1 : inPublicSpace(john) \\ & n1b : inPublicSpace(X) \rightarrow forbidden(X, smoke) \end{aligned}$$

Argument $A_3$ cannot be validly attacked by argument $A_4$ for $\neg applicable(n1b)$

$$\begin{aligned} A_4 == \quad & q1b : norm(n1b) \\ & nl : norm(n1b) \wedge \sim legal(n1b) \rightarrow \neg applicable(n1b) \end{aligned}$$

since $A_4$ is strictly defeated by the argument $A_5$ for $legal(n1b)$, which concludes that $n1b$ is legal (contrary to what was assumed by $nl$ in $A_4$):

$$\begin{aligned} A_5 = \quad & f2a : happens(smokeActEnactment) \\ & f2b : legislativeAct(smokeActEnactment) \\ & f2c : states(smokeActEnactment, n1b) \\ & n2 : happens(X) \wedge legislativeAct(X) \wedge states(X, Y) \rightarrow legal(Y) \end{aligned}$$

Similarly $A_5$ cannot be successfully attacked by $A_6$ for $\neg applicable(n2)$

$$\begin{aligned} A_6 = \quad & q2 : norm(n2) \\ & nl : norm(n2) \wedge \sim legal(n2) \rightarrow \neg applicable(n2) \end{aligned}$$

since $A_6$ is strictly defeated by $A_7$ for $legal(n2)$:

$$\begin{aligned} A_7 = \quad & f3a : happens(costitutionEnactment) \\ & f3b : constitutionalAct(costitutionEnactment) \\ & f3c : states(saleActEnactment, n2) \\ & n3 : happens(X) \wedge constitutionalAct(X) \wedge states(X, Y) \rightarrow legal(Y) \end{aligned}$$

Finally, argument $A_7$ cannot be successfully attacked by $A_8$

$$\begin{aligned} A_8 = \quad & q3 : norm(n3) \\ & nl : norm(n3) \wedge \sim legal(n3) \rightarrow \neg applicable(n3) \end{aligned}$$

since $A_8$ is stricly defeated by $A_9$, which uses postulate $a2$, namely, the postulate specifying that fundamental norms are legally valid, combined with the assumption $a1$ that $n3$ is a fundamental norm (with regard to the considered legal system):[1]

$$\begin{aligned} A_9 = \quad & a2 : fundamental(X) \rightarrow legal(Y) \\ & a1 : fundamental(n3) \end{aligned}$$

[1] We shall not consider here how the postulate that fundamental rules are valid and the assumption that a rule is indeed fundamental are to be viewed for a legal theoretical perspective. These assumption can indeed be viewed as neutral with regard to different legal theories (which according to different evaluative or theoretical assumptions may consider different norms to be fundamental). For a discussion of the concept of legal validity, see Sartor (2007).

In conclusion, no attack can be successfully brought against $A_3$ by attacking the legal validity of its norm $n1b$, either directly or indirectly (namely, by attacking the legal validity of a norm whose legal validity is a precondition of $n1b$'s validity). Thus $A_3$'s conclusion (John's obligation not to smoke) appears to be legally justified.

# 3 Norms in Agent Societies

Source-norms will provide us with a mechanism for enabling agents to autonomously include new norms in their electronic institutions without someone (agent or human) explicitly introducing such norms.

Many scholars are investigating how to make these institutions more autonomous but the autonomy in electronic institutions is often meant as consisting in a chance being given to software agents, namely, the chance:

- to select at run-time the coordination mechanism;
- to choose to be compliant with norms or not;
- to choose which norms to follow in order to achieve individual and social goals

For example, from a coordination point of view in Excelente-Toledo and Jennings (2004) a decision making framework has been defined that enables agents to dynamically select the coordination mechanism in order to fit their prevailing circumstances and their current coordination needs. As regards the autonomy in choosing norms, in Lopez y Lopez et al. (2002) the authors propose a set of strategies to be used by agents and analyse the effects of autonomous norms compliance through simulation experiments. In Fitoussi and Tennenholtz (2000), instead, agents are not constrained to follow the norms but they can select among alternative social laws by exploiting the notions of minimal and simple social laws.

The autonomy in the structure of electronic institutions has been analysed from two points of view. The former concerns the organisational structure and the latter concerns the emergence of laws. In Horling et al. (2001) a general diagnosis engine is defined to drive the adaptation of organisational structures, while in Gasser and Ishida (1991); Ishida et al. (1992) two new reorganisation primitives have been introduced, composition and decomposition, to extend the possible architectures for Organization Self-Design (OSD). In Hubner et al. (2004) the MOISE+ organisation model is proposed as the cooperative framework of MAS reorganisation. On the other hand, the emergence of laws has been studied by many scholars among which Conte (2001); Walker and Wooldridge (1995) to name a few, who have focused on how norms emerge from behaviour.

We think that our model complements the second area of research, since it provides agents with a flexible model for identifying and creating new norms (in our framework, indeed emerging social law can be considered a special kind of customary based norms, which can be binding according, and under the conditions specified by an appropriate source-norm). Since agents can automatically detect source norms, norms need not be built-in constraints for agents: agents themselves can check the existence of norm-generating events, namely, normative sources, and can derive appropriate conclusion, concerning what norms exist and whether they are binding for them. Morover, agent can produce such events (e.g. follow a custom, enact a law, issue a decision based on a certain ratio) in order to create new norms.

# 4 Self-regulated Institutions

We can characterise different kinds of (electronic) institutions, having different kinds and degrees of normative autonomy, according to the kinds of source norms they have. First of all we can distinguish institutions according to the foundation of their source norms:

**Self-regulated institutions** only contain norms which are qualified as valid by source-norms belonging to the institution.

**Other-regulated institutions** also contains norms that are qualified as valid by source-norms not belonging to the institution.

Self-regulated institution can be further distinguished according to the origin of the source-events they take into consideration:

**Non-delegating institutions** only contains source-norms referring to source-facts taking place within the institution.

**Delegating institutions** also contains source-norms referring to source-facts taking place within other institutions.

In order to design the normative infrastructure of a self-regulated institution we need to include not only norms but also source-norms. This will enable agents autonomously and dynamically to know which norms are binding. Moreover they may be able to produce new norms by realising legal source-events, namely, by making so that the facts happen (e.g. a contract) that, according to the source norms, are able to produce further norms.

For agents to be able to appreciate the implications of the source norms, and thus to identify the legally valid norms which have so far been produced, it is necessary to enable them to reason with a knowledge base including both rules and facts. For experimenting with this feature we have used the ASPIC Argumentation Engine (Amgoud et al. 2006) a software implementation – in Java – of the algorithms for defining the status of arguments defined in the European Project ASPIC (http://www.argumentation.org/). It provides a structure to capture defeasible knowledge and reason over the status of query matches (defeated or undefeated), and implements a subset of the logic of PRATOR sufficient for our purpose. ASPIC allows a user to examine the yes (undefeated) or no (defeated) status of each match or to view a graph visualisation of the proof argument network associated with the reasoning argument game. It also provides a machine readable version of the proof and results via AIFXML (http://aspic.acl.icnet.uk/).

In ASPIC predicates are represented in a Prolog-like syntax and can be associated with a real number in the range (0,1] known as “degree of belief” or dob for short. Rules are also associated with a degree of belief. This annotation of the facts and rules in a knowledge base allows us to separate strict knowledge from defeasible knowledge where strict knowledge has a dob of 1.0 and defeasible knowledge has a dob less than 1.0. Software agents may use the ASPIC Argumentation Engine in two different ways: if software agents are developed in Java then they can embed the engine in their Java application; otherwise, they can parse and interpret the AIFXML rulebase.

We have also experimented with Carneades (Gordon 2007), the Inference Engine developed within the European Project ESTRELLA now under development. There are strict and defeasible rules also in Carneades but here it is not necessary to specify the degree of belief for each rule since undercutters are assumed to prevail over the undercut rules (namely, the rules declared to be inapplicable). Also in Carneades as in ASPIC, rules are reified and can be referred to by

means of an identifier (more generally, rules have a set of meta-data properties). We cannot here present in detail Carneades's syntax. Let us just show how norm $nl$ norm would be represented in Carneades:
$(rule\ nl$
$(if\ (and\ (norm\ ?n)$
$(\sim\ legal\ ?n))$
$(not\ applicable\ ?n)))$

# 5 Conclusions and Future Work

We have presented the concept of source-norm, namely, norms establishing what other norms, on basis of what properties, validly belong (or do not belong) to a normative system. This idea is partically connected to Kelsen's fundamental and empowering norms and to Hart's recognition and secondary norms.

We have provided a taxonomy of source-norms, by distinguishing between enactment-recognizing source-norms and practice-recognizing norms and between fundamental and dependent source-norms. We have also shown how source norms can support self-regulated institutions, namely institutions composed by agents that not only obey rules, but also determine what rules are part of the institution's normative system and that create new rules. We have represented source-norms by using the logic of the PRATOR system and have tested their application though the ASPIC Argumentation Engine and the ESTRELLA inference engine.

In future work we intend to refine the model here presented and to use it to study the evolution of agent-societies.

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